

Part II
OPERATING
AND
MAINTENANCE INSTRUCTIONS

50X1-HUM

50X1-HUM

Chapter I

GENERAL

1. The diesel engine operating and maintenance instructions contain the basic directions which must be followed by the crew during servicing the engine.

2. Reliable and trouble-free operation of the diesel engine depends to a great extent on good knowledge of engine design and the peculiarities of its operation, on timely detection and elimination of faults, as well as on the quality of fuel, oil and water used.

3. Servicing of diesel engine may be entrusted only to those who have special certificates to this effect.

FUEL

4. The diesel engine needs grade *ДБ* (GOST 4749-49) diesel fuel for its operation. Diesel fuels *ДБ* (GOST 4749-49) and *С* (GOST 305-62) may be used as substitutes.

Note. Operation on fuel *С* is permissible only in emergency cases, since this fuel may cause intensive wearing of the parts of fuel injection equipment and cylinder and piston groups.

5. The grades of fuel mentioned in Para.4 (except for grade *С*) may be mixed with each other in any proportions.

Foreign fuels of the following grades may be also used for the diesel engine:

- (a) fuel 2-D, according to ASTM Specification D-975-607;
- (b) fuel mentioned in Federal Specification O-361;
- (c) 1st class fuel according to Military Specification MI E-896, in compliance with American classification of oil products;
- (d) fuel with cetane number 47 according to Supply Ministry Specification DE F 2402, in compliance with the British classification of oil products;
- (e) fuel according to State Specification DIN-51601, in compliance with GFR classification of oil products.

6. Before receiving the fuel, do the following:

- (a) check whether the data written down in the fuel certificate correspond to the requirements of the State Standard (GOST);

50X1-HUM

50X1-HUM

GENERAL

1. The diesel engine operating and maintenance instructions contain the basic directions which must be followed by the crew during servicing the engine.
2. Reliable and trouble-free operation of the diesel engine depends to a great extent on good knowledge of engine design and the peculiarities of its operation, on timely detection and elimination of faults, as well as on the quality of fuel, oil and water used.
3. Servicing of diesel engine may be entrusted only to those who have special certificates to this effect.

FUEL

4. The diesel engine needs grade DC (GOST 4749-49) diesel fuel for its operation. Diesel fuels AI (GOST 4749-49) and C (GOST 305-62) may be used as substitutes.

Note. Operation on fuel C is permissible only in emergency cases, since this fuel may cause intensive wearing of the parts of fuel injection equipment and cylinder-and-piston group.

5. The grades of fuel mentioned in Para.4 (except for grade C) may be mixed with each other in any proportions.

Foreign fuels of the following grades may be also used for the diesel engine:

- (a) fuel 2-D, according to ASTM Specification D-975-607;
- (b) fuel mentioned in Federal Specification O-361;
- (c) 1st class fuel according to Military Specification MI E-896, in compliance with American classification of oil products;
- (d) fuel with cetane number 47 according to Supply Ministry Specification DE F 2402, in compliance with the British classification of oil products;
- (e) fuel according to State Specification DIN-51601, in compliance with GFR classification of oil products.

6. Before receiving the fuel, do the following:

- (a) check whether the data written down in the fuel certificate correspond to the requirements of the State Standard (GOST);

138

50X1-HUM

50X1-HUM

- (b) pump the residue out of the service and reserve tanks.
7. Pass the received fuel through the ship filters.
8. Two hours after the fuel has been received, as well as before starting the diesel engine after a standstill period of more than 12 hours, clean the fuel tanks in compliance with the ship instructions.

9. Fill the service tanks with fuel only through separators.

The separated fuel must be completely free of water and the content of mechanical impurities in it should correspond to the requirements laid down in GOST 4749-49 or GOST 305-62. Diesel engine operation on non-separated fuel is not allowed.

Note. To check absence of water in fuel on board the ship, introduce potassium permanganate into a vessel with fuel. If the fuel contains no water, potassium permanganate will not dissolve there.

OIL

10. The diesel engine is to be lubricated only with grade M-20T motor oil, Specifications MPTV 12H No.24-63.

The following foreign grades of oil of Heavy Duty Series II SAE 50, according to American Specification MIL 0-2104, may be also used for lubricating the diesel engine:

- (a) motor oil Essolube SDX 50;
- (b) motor oil Morolabe Mancol SAE 50;
- (c) motor oil Super Valvoline 1000 S-2 50.

11. Before receiving the oil, check whether the data written down in the oil certificate meet the requirements laid down in Specifications MPTV 12H No.24-63.

12. Receive the oil through the ship filters.

13. Before priming the oil into the diesel engine system or when changing the oil, do the following:

- (a) drain waste oil completely out of the diesel engine and the circulating system, including the filters and cooler;
- (b) clean and wash the circulating tank with clean diesel fuel, and then wipe it dry by means of cloth;
- (c) clean and wash the oil filter screens and casings;
- (d) clean the reserve oil tanks thoroughly.

14. Change the oil every 1,000 hours of diesel engine operation. However, the oil is to be changed before this period expires in the following cases:

- (a) if the kinematic viscosity at 100°C drops down below 16 c.s.;
- (b) if the flash point in open cup is lower than 200°C;
- (c) in case the content of mechanical impurities increases above 0.5 per cent;
- (d) if the ash-content is below 1 per cent.

Note. Take oil analysis within the following terms:

- (a) from service tanks - at least every 250 hours of diesel engine operation;
- (b) from reserve tanks - each time during replenishment.

50X1-HUM

50X1-HUM

17. Shift the emergency control station handle to check whether the fuel injection pump control levers, rods and shafts run easily, without jamming. Make sure that the emergency control station handle disengaged from the sector and shifted towards the increase of fuel feed returns to position STOP independently. At the same time, see that the fuel injection pump racks are not jammed.

18. Check sealing of main starting valves, for which purpose close the shut-off valves on the main starting valves, feed starting air to the diesel engine and make sure that no air escapes from the relieving holes of the main starting valves.

19. Check the diesel engine starting system for proper sealing. To this end, close the shut-off valves of the main starting valves, admit starting air into the system by pressing upon the emergency control station starting button, and see that no air is leaking through all the system joints and through the starting valves into the working cylinders. After the check is accomplished, open the shut-off valves on the main starting valves.

20. Cut in and check the signalling of the diesel engine oil scavenging system.

21. Use the independent pump to prime the high-pressure pumps and engine system with fuel. When priming, bleed air from the fuel filters. Change over the system for the supply of fuel to the engine from the fuel feed pump.

22. Supply low-pressure air to the remote control panel and the thermoregulators. Take care to see that the pressure of air is within $4 \pm 0.2 \text{ kgf/cm}^2$. If necessary, adjust the reducer (governor) for this value of pressure. Make sure that the rods of the pneumatic regulating slide valves of the thermoregulators move smoothly, and without jamming (see the thermoregulator maintenance instructions).

23. Prepare the warning signalling system for operation. To do this, proceed as follows:

(a) energize the signal panel; red tell-tale lamps indicating a drop of oil, water and fuel pressure must herein come up on the signal panel, the EMERGENCY STATE (АВАРИЙНОЕ СОСТОЯНИЕ) tell-tale lamp located in the signal box must also come up, and the bell must start ringing;

(b) cut the bell out, in which case signal box tell-tale lamp BELL OFF (ЗВОНОК ВЫКЛЮЧЕН) will come up;

(c) check functioning of the water and oil overheating tell-tale lamps by the check switch.

24. Attach all the hatch doors and coverings removed before.

25. Engage the independent priming and scavenging oil pumps and prime the diesel engine with oil up to a pressure of at least 0.8 kgf/cm^2 (in the feed chamber of the starboard camshaft), as read by pressure gauge OIL located on the engine instrument board. Watch readings of the pressure gauge downstream of the pump on the oil system scavenging pipeline to see if the pump functions properly (the oil pressure must be at least 0.2 kgf/cm^2).

26. Push the emergency control station starting button and crank the diesel engine with air (cranking of diesel engine with air is allowed only in one minute after the oil pressure indicated by the engine instrument board pressure gauge has reached a value of 0.8 kgf/cm^2). After this is done, cut out the independent pumps and close the indicator valves.

27. Disengage the emergency control station handle from the sector and lock it in its free position.

28. To prepare the diesel engine for starting from the emergency control station, shift the control selector switch to CONTROL STATION.

29. To prepare the engine for starting from the remote control panel, proceed as follows:

(a) move the control selector switch handle to position CONTROL PANEL;

130

50X1-HUM

50X1-HUM

(b) disengage the governor speed control handle from the sector and secure it in its position, make sure that the handle sets to position STOP independently,

(c) energize the warning signalling system;

(d) check if starting air is fed to the remote control panel and diesel engine.

Notes to Sub-Section A: 1. The first startings of engine after repairs, overhauls and long periods of standstill (above one month) are to be carried out from the emergency control station only.
2. Additional inspections and checks are determined by the engineering department officer separately for each particular case, depending on the nature of overhauls and repairs carried out.
The procedure of checking is described in Chapter VI of these instructions.

B. Preparing the Diesel Engine for Starting During Daily Operation

30. Inspect the diesel engine and its accessories and arrangements to see that there are no foreign objects on them.

31. Make sure that:

(a) the handles of the emergency control station and the remote control panel, as well as the speed control handle on the governor are in position STOP;

(b) the governor manual load limiter is in a position indicating 103 to 105 per cent on the load scale;

(c) the control selector switch handle is set to CONTROL STATION;

(d) the air pipeline valves are closed;

(e) shut-off valve A (see Fig.39) is open.

32. Engage the shaft barring arrangement worm with the power take-off shaft rim, and lock it in this position.

33. Make sure that all cocks, valves and flaps on the pipelines of diesel engine systems are in positions specified by the ship's instructions.

34. Check level of oil in the speed governor. If necessary, add oil into the governor up to the centre mark available on the oil level indicator.

35. Cut in the water heater and heat the water in the cooling system up to a temperature of at least 40°C above zero by forcing water through the heater and diesel engine with the aid of the independent pump.

Cut out the water heater after warming is accomplished.

36. Open the sea water system kingston valves.

37. Make sure that the oil and fuel filters are cut in for the operation of both sections. Screw out the filter drain plugs and check the oil and fuel for absence of water.

38. Check absence of water in the circulating tank and oil cooler by taking samples from the lower part of the tank and cooler.

39. Check:

(a) amount of oil in the circulating tank, which should be within 2.8 to 3.5 tons;

(b) level of water in the expansion tank; the level must be within 1/2 to 3/4 of the tank height;

(c) amount of fuel in the service tank;

(d) pressure of air in the starting cylinders; scavenge the cylinders to remove condensate.

131

50X1-HUM

50X1-HUM

40. Cut in the oil heater and heat the oil in the circulating tank up to a temperature of at least 40°C above zero by forcing oil through the oil heater with the aid of the independent pump. When heating, take care to see that the oil pressure downstream of the pump is not in excess of 3 kgf/cm^2 (this is to be adjusted by returning part of oil into the tank via the oil pressure adjusting valve).

41. Change over the pipeline valves and force heater oil from the circulating tank through the cooler and filter of the scavenging pipeline until the temperature is at least 30°C above zero (as indicated by the thermometer downstream of the cooler).

Note. Warming of the cooler and filter may be performed along with priming the diesel engine according to Para.47 by scavenging the oil from the engine sump through the filter and cooler.

42. Shift the emergency control station handle to check whether the fuel injection pump control levers, rods and shafts run easily and without jamming. Make sure that the emergency control station handle disengaged from the sector and shifted towards the increase of fuel feed returns to position STOP independently. At the same time, see that the fuel injection pump racks are not jammed.

43. Prime the fuel system by means of the independent pump. Bleed air out of the fuel filters.

44. Supply low-pressure air to the remote control panel and thermoregulators. Take care to see that the pressure of air is within $4 \pm 0.2 \text{ kgf/cm}^2$. If necessary, adjust the reducer (governor) for this value of pressure. Scavenge the air filters until condensate is completely removed. Make sure that the rods of the pneumatic regulating slide valves of the thermoregulators move smoothly and without jamming (see the thermoregulator maintenance instructions).

45. Prepare the warning signalling system for operation. To do so, adopt the following procedure:

(a) energize the signal panel; red tell-tale lamps indicating a drop of oil, water and fuel pressure must herein come up on the signal panel, the EMERGENCY STATE tell-tale lamp located in the signal box also come up, and the bell must start ringing;

(b) cut the bell out, in which case signal box tell-tale lamp BELL OFF will come up;

(c) check functioning of the water and oil overheating tell-tale lamps by the check switch.

46. Cut in the signalling of diesel engine oil scavenging system.

47. Engage the independent priming and scavenging oil pumps, prime the engine with oil, and at the same time turn the engine by means of the shaft barring arrangement through 1 to 1.5 revolutions (as to the power take-off flange).

Check the supply of oil to the diesel engine by the readings of pressure gauge OIL located on the engine instrument board (the pressure should be at least 0.8 kgf/cm^2).

Scavenging of oil from the diesel engine sump is to be checked by the readings of the pressure gauge downstream of the scavenging pump.

Notes: 1. During the entire period spent on preparing the diesel engine for starting, prime the engine periodically with oil, and maintain herein the engine oil outlet temperature within at least 40°C above zero. Do not prime the engine with oil for a period exceeding 10 minutes.

2. In all cases when cranking the diesel engine by means of the shaft barring arrangement or air, keep the indicator valves open.

48. Cut out the shaft barring arrangement, disengage it from the power take-off flange and secure it in this position.

49. Admit starting air to the diesel engine, push the emergency control station starting button and crank the engine with air (cranking of the diesel engine with air is allowed only in one minute

50X1-HUM

50X1-HUM

after the oil pressure indicated by the engine instrument board pressure gauge has reached a value of 0.8 kgf/cm^2 . After this is done, cut out the independent pumps and close the indicator valves.

50. Disengage the emergency control station handle from the sector and lock it in its free position.

51. To prepare the diesel engine for starting from the emergency control station, shift the control selector switch handle to CONTROL STATION.

52. To prepare the diesel engine for operation from the remote control panel, proceed as follows:

- (a) move the control selector switch handle to position CONTROL PANEL;
- (b) disengage the governor speed-control handle from the sector and secure it in its free position; make sure that the handle occupies position STOP independently;
- (c) energize the warning signalling system;
- (d) check if starting air is fed to the remote control panel and diesel engine.

- Notes to Sub-Section B:
- 1. The first starting of engine with the aim of warming it up is to be carried out from the emergency control station. After the engine is warmed up, the control may be changed over to the remote control panel.
 - 2. If the diesel engine is being prepared for starting after a short period of standstill, and all its systems have been prepared and checked beforehand (at water and oil temperature in the engine and systems being at least 40°C above zero), the preparation for starting may be carried out as follows:
 - (a) prime the engine with oil in the course of 2 to 3 minutes;
 - (b) admit starting air to the remote control panel and the diesel engine.

Starting the Diesel Engine from the Emergency Control Station

On receiving the command to start the diesel engine, do the following:

53. Engage the independent priming and scavenging oil pumps. Set the governor speed-control handle to scale division "3" and lock it in this position. In one minute after the oil pressure read by the instrument board pressure gauge reaches a value of 0.8 kgf/cm^2 (the pressure gauge fitted downstream of the scavenging pump should herein indicate a pressure of at least 0.2 kgf/cm^2), shift the emergency control station handle to scale division "5", keep the handle in this position and push the starting button. As soon as firing appears in the cylinders and the diesel engine starts accelerating its speed, release the starting button and use the emergency control station handle to prevent acceleration of engine speed above 400 to 450 r.p.m. After a steady speed of 350 to 400 r.p.m. is obtained, release the emergency control station handle slowly. Further change of diesel engine operation ratings is to be done by means of the speed-control handle on the governor.

Having started the diesel engine, proceed as follows:

54. As soon as the engine starts operating on fuel, and the pressure indicated by pressure gauge OIL reaches the normal value, cut out the independent oil pumps.

55. Listen to the engine to make sure that it operates properly; check the pressure of oil, fuel, fresh and sea water by the readings of pressure gauges mounted on the instrument board.

56. Two or three minutes after the diesel engine is started, close the cocks on the drain pipes of the receiver and exhaust manifolds.

133

50X1-HUM

50X1-HUM

Starting the Diesel Engine from the Remote Control Panel

On receiving the command to start the diesel engine, do the following:

57. Engage the independent priming and scavenging oil pumps and then, one minute after the permissive signals come up, shift the control panel handle to scale division "2.5 - 3" within the OPERATION zone. When the diesel engine speed increases, move the control panel handle quickly behind division "3.5" (to shut-off the starting air) and return it immediately back, after which move the control panel handle within the OPERATION zone until the required engine speed is obtained.

Having started the diesel engine, proceed as follows:

58. As soon as the engine starts operating on fuel, and the pressure indicated by pressure gauge OIL reaches the normal value, cut out the independent oil pumps.

59. Cut in the sound signal of the warning signalling system and make sure that WORKING STATE (РАБОЧЕЕ ПОЛОЖЕНИЕ) tell-tale lamp comes up in the signal box.

60. Check the pressure of oil, fresh and sea water by the readings of the panel pressure gauges.

61. Two or three minutes after the diesel engine is started, close the cocks on the drain pipes of the receiver and exhaust manifolds.

Changing Over the Control from the Remote Control Panel to the Emergency Control Station, and Vice Versa, During Diesel Engine Operation

62. When changing over the control from the remote control panel to the emergency control station, do the following:

(a) lock the governor speed-control handle in the position occupied by it;
(b) set the control selector switch handle in position CONTROL STATION;
(c) turn the panel cock to position CLOSED (ЗАКРЫТО), to shut off the supply of starting air to the remote control panel;

(d) set the control panel handle in position STOP;

(e) carry out further control of diesel engine from the emergency control station.

63. When changing over the control from the emergency control station to the remote control panel during engine operation, do as described below:

(a) following the below approximate Table which shows the correspondence of the divisions on the scales of the panel and governor, set the control panel handle to one division less than it is specified in the Table for this particular operation rating:

Panel scale	3	4	5	6	7	8	9
Governor scale	5 - 7	8 - 9	10 - 11	12 - 13	14 - 15	16	17

(b) set the control panel cock in position OPEN (ОТКРЫТО) to admit starting air to the panel;

(c) disengage the governor speed-control handle from the sector and secure it in its free position;

(d) shift the control selector switch handle to CONTROL PANEL;

(e) adjust the diesel engine speed in compliance with the predetermined operation rating, for which purpose use the knob on the panel handle;

(f) further control of the engine is to be exercised from the remote control panel.

50X1-HUM

50X1-HUM

SERVICING THE DIESEL ENGINE DURING OPERATION

64. To reduce wear of friction parts during daily operation, prior to bringing the diesel engine to full power run it at the following ratings:

- slow-speed - for at least 5 minutes;
- half speed - for at least 5 minutes;
- full speed - for at least 5 minutes.

The change-over from full to flank speed must be done gradually in the course of at least two minutes.

When starting and warming-up the diesel engine on the anchored ship, see that the blades of the variable-pitch propeller (VPP) are in a position corresponding to the position of the pointers of the outboard pitch indicator (OPI) at mark O.

Note. If the engine running at ratings not lower than the half speed has been stopped for a short period of time (up to 15 min), and the temperature of water and oil in the diesel engine and its systems has not dropped down lower than 40°C above zero during the standstill period, the started engine may be then brought to full power gradually in the course of 3 minutes.

65. In emergency cases, the diesel engine prepared for starting in accordance with Sub-Section "Preparing the Diesel Engine for Starting During Daily Operation" should be warmed-up at slow speed rating for three minutes, then at half speed rating until the engine oil and water outlet temperature is 40°C above zero. Now the engine may be brought to full power with gradual increase of speed in the course of three minutes.

Note. The time passing from the moment of starting up to the development of full power in emergency cases is roughly 10 minutes.

66. Do not run the engine idle for more than 30 minutes, and do not run it at dead slow for longer than 1 hour.

Note. If a longer period of slow speed operation is required, run the engine for 10 to 15 minutes at full speed after each hour of its slow speed operation so as to prevent formation of carbon in the gas exhaust flow path.

67. During diesel engine operation, watch readings of measuring instruments, inspect the engine and its systems and listen to the engine every hour of its operation. When operating the diesel engine from the remote control panel, ensure stable operation of the air reducers, so as to maintain the given speed (with the engine controls being unchanged).

68. Change over the engine from one rating to the other gradually, without abrupt change of speed.

69. As soon as the engine develops the required rating, write down its speed in the Log Book. Thirty minutes after the rating has been obtained, and then every 4 hours of operation (in case the engine operates continuously at this steady rating), make the following records in the Log Book:

- (a) diesel engine speed;
- (b) position of governor load indicator pointer;
- (c) temperature of exhaust gases in cylinders and manifolds;
- (d) engine oil outlet temperature;
- (e) engine fresh water outlet temperature;
- (f) engine oil inlet pressure;

13
50X1-HUM

50X1-HUM

2/008

engine

■

two

s of

ters c

a shor

gine

still

e of

Section

slow

tempe

of spe

in em

or long

minute

of ca

engine

l engi

the

of

ook.

e the

sk:

Temperature of exhaust gases in cylinders, °C	up to 480
Difference in exhaust gas temperatures between cylinders, °C	up to 100
Temperature of exhaust gases in starboard and portside manifolds (upstream of turbine), °C	up to 500
Engine oil outlet temperature, °C	70 to 75
Engine fresh water outlet temperature, °C	65 to 70
Engine oil inlet pressure, kgf/cm ²	at least 4
Engine fresh water inlet pressure, kgf/cm ²	at least 1.0
Pressure of sea water downstream of pump, kgf/cm ²	at least 1.0
Rarefaction in crankcase, mm of water	30 to 60
Maximum over-revving at any rating, r.p.m.	up to 100

74. During engine operation at minimum speed, observe the following

basic ultimate parameters:

Deviation of speed (for a warmed-up engine), r.p.m.	±15
Engine oil inlet pressure, kgf/cm ²	1.5
Engine fresh water inlet pressure, kgf/cm ²	at least 0.3
Pressure of sea water downstream of pump, kgf/cm ²	at least 0.3
Deviation of speed at idle running, r.p.m.	up to ±50

⊗ 75. During turning of the ship at any rating, the temperature of exhaust gases in manifolds (upstream of the turbine) may rise by 40° as compared to the gas temperature obtained during the engine steady operation rating before turning began.

Besides, when the ship is being turned at diesel engine rated speed, the following should be observed:

- (a) the temperature of exhaust gases in manifolds should not exceed 500°C;
- (b) the drop of crankshaft speed (diesel engine operation at outer performance caused by the controls set to the maximum fuel stop) should not exceed 50 r.p.m.

In case the temperature of exhaust gases exceeds the above value, reduce the load by lowering down the speed. Do not run the engine at outer performance ratings (during turning of the ship) longer than 10 min.

CAUTION. On ships where the turning procedure usually causes overloading of engines above the values indicated in Para.75, reduce the engine speed down to 800 r.p.m. before turning the ship.

76. Ensure continuous separation of oil during diesel engine operation. The separator oil inlet temperature should not be lower than 55°C.

Note. During engine operation at slow speed, oil is fed to the separator through the cooler.

77. When the engine operates, take care to engage both sections of the oil filters on the suction and delivery lines of the lubricating system. Never examine the filtering cartridges of the delivery line oil filters during operation of the diesel engine.

78. Every 100 hours of operation, carry out complete measurement of diesel engine service parameters, with the engine running at rated speed.

When measuring:

- (a) attach periodic control instruments to the engine;

50X1-HUM

50X1-HUM

(b) check the pyrometer to make sure that its resistance and the setting of galvanometer pointers to the ambient air temperature correspond to the requirements laid down in the respective certificates;

(c) see if the speed indicated by the summing counter is within 845 to 855 r.p.m., and that the difference in the speeds ensured by diesel engines of a double-shaft installation is not in excess of 5 r.p.m.;

(d) measure the parameters not earlier than 30 minutes after the necessary rating has been obtained.

In addition to the parameters specified in Para.69, measure also the following ones:

- (a) engine oil inlet temperature;
- (b) engine fresh water inlet temperature;
- (c) combustion pressure in cylinders;
- (d) gap in maximum fuel feed stop;
- (e) position of indicators of both pneumatic regulating slide valves;
- (f) temperature of sea water at the inlet and outlet of each air cooler;
- (g) rarefaction in crankcase.

If during these measurements it is found that:

- (a) the drop of diesel engine temperature is above 22°C ;
- (b) the drop of diesel engine fresh water temperature is lower than 4°C ;
- (c) the difference in sea water temperature drop in portside and starboard coolers is above 4°C ;
- (d) the rarefaction in engine crankcase is below 20 or above 60 mm of water, then stop operation of diesel engine until all these faults are eliminated.

Note. Rarefaction is to be measured in the upper crankcase, near the 16th cylinder.

To adjust the value of rarefaction in the crankcase, select proper section of the throttling washer at the suction from the upper crankcase oil separator.

When determining the necessity of readjustment, bear in mind that during the first 30 to 50 hours of engine operation after the reassembly of the connecting-rod-and-piston groups the value of rarefaction in the crankcase will get reduced.

79. In emergency cases, when the diesel engine is cooled with sea water, reduce the r.p.m. down to the level not exceeding half speed; to prevent intensive deposition of salts, take herein care to see that the engine water outlet temperature is not higher than 50°C above zero.

● STOPPING THE DIESEL ENGINE

80. Before stopping the diesel engine after its continuous full-power operation, reduce first the r.p.m. smoothly down to low speed, and then run the engine at this rating in the course of 5 to 10 minutes.

81. To stop the diesel engine, proceed as follows:

- (a) if the engine is operated from the remote control panel, shift the panel handle to position STOP;
- (b) if the engine is operated from the emergency control station, set the governor speed-control handle in position STOP.

82. After the engine is stopped, put it out of operation, as follows:

- (a) open the indicator valves;
- (b) open the cocks on the drain pipes of the receiver and exhaust manifolds;

50X1-HUM

50X1-HUM

(c) prime the engine with water by means of the independent pump until the engine water outlet temperature lowers down to $45 - 50^{\circ}\text{C}$;

(d) scavenge the oil out of the diesel engine and the system scavenging pipeline with the aid of the independent oil scavenging pump;

(e) close the valve of the pipeline which supplies starting air to the diesel engine, and close also the cock on the remote control panel;

(f) close the Kingston valves of the sea water system;

(g) cut out the warning signalling system;

(h) cover the inlet branch pipe of the air intake well.

83. To keep the stopped engine always ready for immediate starting, both independent oil pumps should be cut in.

Note. With the engine stopped, continuous operation of the independent oil pumps during more than 5 minutes is not advisable, while their continuous operation in the course of more than 10 minutes is not allowed at all.

84. Immediately after the diesel engine operating at full or flank speed has been stopped due to an emergency case, do the following:

(a) fulfil the requirements laid down in Para.82c;

(b) engage the independent priming and scavenging pumps and prime the diesel engine with oil in the course of 2 to 3 minutes; along with priming, it is advisable to turn the engine by means of the shaft barring arrangement through 1 or 2 complete revolutions with regard to the power take-off flange.

85. In case the engine is to be stopped for a continuous period of time, and the temperature in the engine compartment is lower than 5°C above zero, pressure-wash the engine with water, as indicated in Para.82c, after which drain the fresh and sea water out of the engine cooling system.

86. If the engine is supposed to be standstill during not less than 12 hours, run the engine in the course of 3 to 5 minutes with dehydrated fuel from the reserve tank, and only then stop it.

☛ Starting the Cold Diesel Engine and Bringing It to Full Power in Emergency Cases

87. Starting of the cold diesel engine is done in emergency cases from the emergency control station only.

88. To prepare the cold engine for starting, follow Section "Preparing the Diesel Engine for Starting During Daily Operation", but bear in mind the alterations and additions given below:

(a) heat the water in the cooling system until the engine water outlet temperature is at least 20°C above zero; *prime the engine with oil until outlet oil is $+20^{\circ}\text{C}$ min;*

(b) prime the oil system scavenging pipeline with oil until the oil temperature in this system reaches a value not lower than 20°C above zero;

(c) close the shut-off valves on one of the main starting valves and on the pipe which supplies air to the fuel feed limiter servo-motor during starting.

89. After the cold engine is started, run it at slow speed for at least 3 minutes, then at half speed until the diesel engine water and oil inlet temperature is not lower than 40°C above zero.

Note. The time passing from the moment of starting the engine from cold up to the development of full power in emergency cases is roughly 15 minutes.

139

50X1-HUM

50X1-HUM

Now the diesel engine may be brought to full power, for which purpose increase its speed gradually in the course of at least 3 minutes.

Measures to Be Taken when a Signal is Sent by the Warning Signalling System

90. As soon as sound and light signals are given (the red tell-tale lamp in the signal box comes up), do the following:

- (a) determine the wrong parameter indicated by the signal on the signal panel, after which cut the bell out;
- (b) watch the readings of respective instruments to find out the value of the parameter which was the cause of the signal;
- (c) reduce the engine r.p.m. down to slow speed rating and change over the engine control to the emergency control station.

91. In case the oil pressure drops, stop the diesel engine immediately. Cut in the independent priming and scavenging pumps and prime the engine with oil.

After this is done, proceed as follows:

- (a) make sure that the oil pipeline is sealed properly;
- (b) check level of oil in the circulating tank;
- (c) check functioning of the engine oil pump reducing valve.

92. In case the cooling water pressure drops down, reduce the engine r.p.m. down to half speed, and check the following:

- (a) level of water in the expansion tank;
- (b) absence of air in the cooling system.

If it is impossible to detect and eliminate the cause of the fault (and the water temperature starts herein rising), stop the engine and at the same time engage the independent water pump.

93. In case the cooling water or oil get overheated, reduce the diesel engine r.p.m. down to slow speed rating. Detect and eliminate the fault in compliance with the directions given in Chapter III.

94. Should the fuel pressure drop down, do the following:

- (a) check the level of fuel in service tanks;
- (b) use the stand-by fuel pump to pressure-test the system with fuel; check herein proper sealing of pipelines and the non-return shut-off valves at the suction line (near the tank) of the engine standard fuel feed pump.

Note. In all cases when stopping the diesel engine, observe the respective requirements laid down in Section "Stopping the Diesel Engine" of these Instructions. The first starting of the engine stopped in emergency should be performed from the emergency control station.

Measures to Be Taken when the Safety (Explosion-Proof) Valves Operate

95. As soon as the diesel engine receiver safety valves operate, do the following:

- (1) Stop the engine immediately. Prime the diesel engine with oil and water, as described in Para.84. Do not open the engine handholes for a period of 15 to 20 minutes.
- (2) Uncover all the inspection holes of the receiver and the exhaust manifolds at the 8th and 16th cylinders, remove the oil accumulating in the receiver and manifolds, clean and scavenge the drain pipes.

140

50X1-HUM

50X1-HUM

(3) Examine the exhaust silencer of the ship installation, check and clean, if necessary, the silencer oil drain line, or remove fuel, if any, from the exhaust path.

If during inspection of the receiver, exhaust manifolds and silencer the cause of safety valve operation is not found out, and if accumulation of fuel is detected in the exhaust path, do the following in addition:

(a) remove the speed governor actuating mechanism and the covering of the camshaft gear (on the opposite row of cylinders), and make sure that intermediate gears 3 and 5 (Fig. 15a) of the fuel injection advance angle adjusting mechanism are meshed with buffer gear 4 and with gears 80 (Fig. 15b) of both camshafts, and that both locks 9 of stops 7 are in their seats. Set the locks of the stops correctly, if needed;

(b) check the fuel injection advance angles on one of the cylinders of each row and adjust the angles correctly, if necessary, in compliance with the directions given in Sub-Section C of Chapter VI;

(c) at the same time, set the emergency control station handle to position STOP, start the diesel engine with air, and check each high-pressure pipe (to the touch) to make sure that the pumps do not feed fuel. If it is found out that one of the pumps feeds fuel, replace the pump.

(4) After all the checks are accomplished, and the faults eliminated, proceed as follows:

(a) open the indicator valves and turn the diesel engine crankshafts through several revolutions by means of starting air;

(b) prepare the engine for starting and start it from the emergency control station.

Having run the engine at slow speed for 10 to 15 minutes, make sure that:

(a) no fuel flows out of the drain pipes of the receiver and exhaust manifold;

(b) no fuel flows out of the open indicator valves.

96. In case the safety valves on the engine crankcase coverings operate, do the following:

(a) stop the engine immediately and prime it with water and oil according to the directions given in Para. 84;

(b) do not open the engine handholes for 15 to 20 minutes;

(c) find the place of vapour flashing in the crankcase (by looking for the sections with blackened surface);

(d) detect and eliminate the cause of oil vapour flashing.

To detect the cause of flashing of vapours in the crankcase, do the following:

(1) Uncover all the engine safety and inspection holes, after which:

(a) examine and check (to the touch) all the main, crankpin and end bearings, and also the bow thrust bearing of the main drive;

(b) inspect the shelves of the upper and lower crankcase halves with the aim of detecting accumulation of chips on them;

(c) disassemble and inspect the filtering cartridges of the oil filter fitted on the scavenging pipeline.

(2) In case bronze chips are found in the filter and on the frame shelves, do as follows:

(a) remove the upper covering and the side coverings of the lower crankcase;

(b) find out the place where chips accumulate;

(c) take out the respective piston, or disassemble the bearing;

(d) disassemble the piston, replace the connecting rod end bushing and the piston pin, or replace the half-bush of the respective bearing.

141

50X1-HUM

50X1-HUM

(3) If the frame shelves are free of bronze chips, but chips are found in the oil filters, do the following:

- (a) check the axial play of the turbo-supercharger rotor;
- (b) check the axial play of camshafts;
- (c) remove the minor accessories drive and examine the stern thrust bearing of the main drive.
- (4) In case large amount of steel chips and babbitt spangles are detected in the filters, proceed

as follows:

- (a) inspect the crankshaft thrust half-rings;
- (b) remove the respective handhole covers and coverings and measure the clearances in the main drive bearings; replace the bearing bushes or bushings, if necessary;
- (c) disassemble the major accessories drive, detect and eliminate the fault.

Peculiarities of Operating the Diesel Engine on Units with Variable-Pitch Propeller and "Linija" Control System

97. To connect the diesel engine remote control panel to the engine actuating mechanism in the "Linija" control system do the following:

- (a) energize the "Linija" system;
- (b) engage the pump of the variable-pitch propeller;
- (c) set the blades of the variable-pitch propeller in a position corresponding to the position of the outboard pitch indicator pointers at mark "0", and shift the handle of the "Linija" system panel to position "STOP";
- (d) prepare the engine for starting, and start it from the remote control panel, after which set the panel handle between divisions "3 - 3.5";

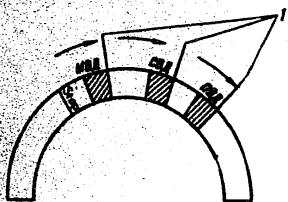


FIG. 74. ACCELERATION OF DIESEL ENGINE SPEED

1 - position of panel handle: SLOW AHEAD (NBA/D); HALF AHEAD (CBA/D); FULL AHEAD (FBA/D)

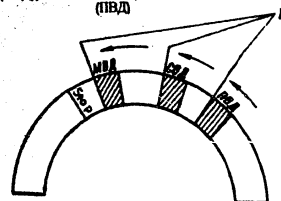


FIG. 75. DECELERATION OF DIESEL ENGINE SPEED

1 - position of panel handle: FULL AHEAD (FBA/D); HALF AHEAD (CBA/D); SLOW AHEAD (NBA/D)

- (e) connect the engine operating mechanism of the "Linija" system to the remote control panel;

- (f) make sure that with the "Linija" system panel handle being in position STOP, the engine develops a speed of 420 ± 10 r.p.m.

98. When exercising control by the "Linija" system, set the system panel handle within the zones of the respective speeds marked on the panel scale, in positions shown in Figs 74 and 75).

99. When connecting the diesel engine remote control panel to the engine actuating mechanism, follow the directions laid down below:

- (a) during ship travel (when the "Linija" system panel handle is within the FUEL SPEED zone) the engine r.p.m. should correspond to rated values;
- (b) when the "Linija" system panel handle is in position STOP, the diesel engine must develop a speed of 420 ± 10 r.p.m.

Readjustment of engine speed is done by changing the tension of the engine remote control servo-motor spring

50X1-HUM

50X1-HUM

*Chapter III***MOST CHARACTERISTIC ENGINE TROUBLES,
THEIR CAUSES AND REMEDIES**

Cause	Remedy
1. Engine fails to develop speed when started with air (power take-off flange starts rotating, does not make a complete turn, and stops):	
(a) air pressure in starting cylinders insufficient;	(a) charge the starting cylinders with air until the pressure is within rated values;
(b) reducers (governors) damaged or frozen;	(b) check and eliminate the fault;
(c) working cylinder starting valves loose or sticky;	(c) pressure-test the starting valves with air in compliance with the directions given under heading "Working Cylinder Starting Valve" of Chapter V. Remove the defective valves, replace them by spare ones, or disassemble them, run them in with oil, lap and then assemble. Pressure-test the starting valves again;
(d) pipes running from starting valves to air distributors attached wrongly, or damaged;	(d) check condition and correct attachment of the pipes running from the starting valves to the air distributors in accordance with the cylinder numbers punched on the air distributor housings;
(e) slide valves fitted incorrectly with regard to air distributor drums;	(e) check the slide valves and fit them correctly, if necessary, in accordance with the directions laid down under heading "Starting Air Distributor" of Chapter V;
(f) air distributor slide valve working surface scored. Starting air gets herein into several cylinders simultaneously;	(f) cut out the faulty air distributor by closing the valve admitting air to the air distributor, then start the diesel engine with the other row of cylinders; At the first opportunity lap the slide valve working surface on a surface plate;

50X1-HUM

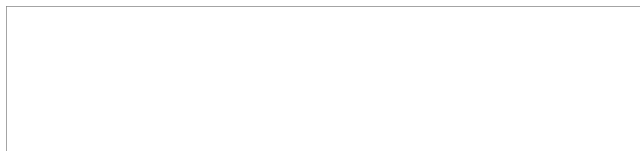
50X1-HUM



Cause	Remedy
(b) pressure of air in low-pressure system insufficient (on control panel setter);	(b) check pressure of air upstream and downstream of control panel setter (see Para. 2 of Appendix 2);
(c) jamming in governor remote control mechanism;	(c) check easy travel of the governor remote control mechanism from the control panel; make sure that the starting air pipeline valve is herein closed;
(d) fuel injection pump control rods, shafts and levers jammed.	(d) check the fuel injection pump control rods, shafts and levers, and eliminate jamming, if any.
5. Engine operation unsteady (engine fails to maintain the given r.p.m.)	
(a) tough travel or jamming of fuel injection pump racks;	(a) check all fuel injection pump racks for easy travel. Ensure easy travel of racks, if tough;
(b) too large clearances, or jamming, in fuel injection pump control rods, shafts and levers;	(b) reduce the clearances, or eliminate jamming;
(c) speed governor malfunctioning.	(c) see Appendix 1, Section "Main Troubles in Governor Operation, Their Causes and Remedies".
6. With governor speed-control handle set to scale division "16", diesel engine fails to develop rated speed; the temperature of exhaust gases in cylinders and upstream of turbine reaches herein the upper limit	
(a) engine overloaded (fouling of ship's hull, navigation in shallow water, strong adverse wind, stormy sea, faulty propeller, too large turning angle of variable-pitch propeller blades);	(a) reduce the engine speed until the cause of overloading is detected;
(b) injectors mounted wrongly: left-hand injectors fitted instead of right-hand ones, and vice versa;	(b) check mounting of injectors according to Section "Fuel Injection Equipment" of Chapter V;
(c) fuel injection advance angle too small;	(c) check the fuel injection advance angle and increase it, if necessary, in compliance with the directions given in Sub-Section "C" of Chapter VI;
(d) water gets into fuel.	(d) check presence of water in fuel filters and service tank; drain the water and fuel from the diesel engine fuel system. Overhaul the fuel injection equipment. Supply clean fuel to the diesel engine, prime the system and the fuel injection pumps with clean fuel, then prepare the engine for starting, and start it.

145

50X1-HUM



50X1-HUM

Cause	Remedy
7. With governor speed-control handle set to scale division "16", diesel engine fails to develop rated speed; the temperature of exhaust gases is herein too low	
(a) sections of transmission from speed governor to fuel injection pump racks disadjusted;	(a) adjust the linkage between governor and fuel injection pump racks according to directions given in Sub-Section "Checking Proper Linkage of Control Rods and Levers with the Emergency Control Station, Governor, Fuel Injection Pumps and Overspeed Governor" of Chapter VI;
(b) rack of one or several fuel injection pumps jammed;	(b) in case the rack is jammed, disengage it from the control shaft and secure it in the disengaged position. Replace the fuel injection pump at the first opportunity;
(c) maximum fuel feed stop set wrongly.	(c) check position of fuel injection pump racks, with the emergency control position handle being set to the maximum fuel feed, in compliance with directions given in Sub-Section B of Chapter VI.

8. White, vapour-like exhaust of diesel engine

(a) water gets into exhaust manifolds;

(a) pressure-test the diesel engine with water, find and eliminate the cause of entrance of water into manifolds;

(b) air cooler leaky.

(b) stop the diesel engine. Before stopping the engine, open the cocks on the receiver drain pipes. Disconnect the faulty cooler and pump out the oil from the sump into the tank for dirty oil. Check the oil filters and oil service tank for absence of water. Check condition of the cylinder-and-piston group of stern cylinders. Pressure-wash the engine with clean oil and prepare it for starting.

9. Temperature of fresh water and oil increases during diesel engine operation

(a) sea water pump delivery insufficient; water pressure downstream of pump below normal;

Reduce the engine speed until the causes of water and oil overheating are detected.

(b) sea water cavities in water and oil coolers clogged. Pressure of sea water downstream of pump above normal;

(a) check opening of intake kingston valve. Clean the filters on the sea water pump intake pipe;

(b) examine and clean the sea water cavities of water and oil coolers;

50X1-HUM

50X1-HUM

Cause	Remedy
<p>12. Deviation of water pressure in cooling system, as well as throw of water out of expansion tank take place during diesel engine operation. Throw of water is noticed also during engine stopping</p> <p>(a) air gets into cooling system;</p> <p>(b) gas escapes from working cylinders into cooling cavities through gaskets on injector and starting valve pipe unions, or through rubber sealing rings of cylinder sleeves in exhaust manifold sections.</p>	<p>(a) bleed air out of cooling system and fill the expansion tank with water up to the specified level;</p> <p>(b) pressure-test the diesel engine with water by means of the independent pump, find out the cause and eliminate the fault.</p>
<p>13. Slow lowering or gradual rising of water level in expansion tank during diesel engine operation</p> <p>Water leaks through water cooler pipes or along tube plate periphery (through soldered joints).</p>	<p>Lower down the engine speed and vary the opening of sea water pipeline kingston valves to obtain such a position in which the pressure of fresh water is higher than that of sea water (i.e. the level in the expansion tank becomes lower). Repair the cooler at the first opportunity.</p>
<p>14. Deviation of diesel engine oil inlet pressure and frothing of oil in circulating tank during engine operation</p> <p>Reducing valve by-passes too much oil from delivery cavity into suction cavity of oil pump delivery section due to insufficient tension of valve spring. Valve vibrates during engine operation, and opens at a pressure below normal; pump capacity gets reduced. Acceleration of diesel engine speed causes no increase of oil pressure downstream of pump.</p>	<p>Tighten up the reducing valve spring during pump operation.</p>
<p>15. Increased oil consumption, accompanied by smoky gas exhaust (blue smoke) and by throwing oil in the form of drops through the exhaust manifold</p> <p>(a) incorrect mounting of oil-control rings on one or several pistons;</p>	<p>(a) stop the diesel engine, uncover the exhaust manifold handholes, watch the traces of oil leakage on the manifold inner surface and find the piston with incorrectly mounted or sticky oil-control rings. Eliminate jamming of rings;</p>

50X1-HUM

50X1-HUM

Cause	Remedy
(d) jamming of servo-motor in governor.	(d) See Appendix I, Section "Main Troubles in Governor Operation, Their Causes and Remedies".
18. Temperature of exhaust gases in one of the cylinders rises	Cut out the bow and stern fuel injection pumps alternately and find out which of them causes higher temperature of exhaust gases and lower value of combustion pressure during operation
(a) fuel injection advance angle disadjusted;	(a) check the fuel injection advance angle and compare it to the values specified in the Service Log. If necessary, adjust the fuel injection advance angle in accordance with directions given in Sub-Section C of Chapter VI;
(b) injectors faulty or disadjusted.	(b) check the injectors in compliance with directions given in Section "Fuel Injection Equipment" of Chapter V.
19. Too high exhaust gas temperature in cylinders of one row	
(a) constant pressure valve on the fuel pipeline of the other row of cylinders stickly;	(a) eliminate the fault. Pressure-test the fuel pipeline and ensure similar return of fuel in both cylinder rows;
(b) exhaust pipeline screen clogged;	(b) uncover and clean the screen;
(c) fuel injection advance angle in one cylinder row disadjusted.	(c) check the fuel injection advance angle in the cylinder rows according to directions given in Sub-Section C of Chapter VI; eliminate the fault.

50X1-HUM

50X1-HUM

*Chapter IV***SCHEDULED PREVENTIVE INSPECTIONS
AND REPAIRS****INSPECTION No.1 (Daily)**

1. Carry out outer inspection of the diesel engine and remove foreign objects.
2. Turn the valves, plugs, cocks and drives of the diesel engine auxiliary systems and secure them in the initial position.
3. Check level of fuel, oil and fresh water in the service, circulating and expansion tanks respectively. Discharge the residue from the fuel service tank and oil circulating tank, and top up the tanks to normal level.
4. Check oil level in the speed governor and add oil, if necessary, up to the centre mark available on the oil level indicator. Check level of lubricant in the shaft barring arrangement with the aid of the dipstick, and replenish, if insufficient.
5. Check pressure of air in the starting cylinders, remove the condensate and charge the cylinders with air, if needed, up to normal value. Make sure that the reducing valves of diesel engine starting and control systems function properly.
6. Check supply of air to the water and oil thermoregulators, and scavenge the air filter so as to remove condensate. Make herein sure that the rods of the thermoregulator pneumatic regulating slide valves move smoothly and without jamming.
7. Inspect the remote control panel and the emergency control station on the diesel engine. Shut off the supply of starting air and do the following:
 - (a) make sure that the handles of the remote control panel, engine emergency control station, control selector switch, as well as the governor speed-control handle, move freely and without jamming;
 - (b) check connection between the fuel injection pump racks and control rods, and see that they travel freely and without jamming;
 - (c) make sure that there are no increased clearances or jamming in the joints of levers, shafts and rods which link up the governor with the fuel injection pumps and with the emergency control station; lubricate the joints with oil, if necessary.

151 50X1-HUM

50X1-HUM

8. Set and secure the remote control panel handle, the emergency control station handle and the governor speed-control handle in position STOP, while the handle of the control selector switch is to be set and secured in position CONTROL STATION.

9. Check functioning of oil and water heaters, as well as oil, fuel and fresh water independent pumps. Engage the independent priming and scavenging pumps, prime the diesel engine with oil, and at the same time turn the engine by means of the shaft barring arrangement through 1 to 1.5 revolutions (as to the power take-off flange); see that the indicator valves are herein open.

Note. If the oil temperature is lower than 15°C above zero, heat the oil in the circulating tank up to a temperature of 25 to 30°C , and only then prime and crank the diesel engine.

10. After cranking of engine is accomplished, pump the oil from the sump into the circulating tank with the aid of the independent pump, and make sure that the remote control panel handle, the emergency control station handle and the governor speed-control handle are set and locked in position STOP.

INSPECTION No.2

(Carried out weekly, in cases when the diesel engine standstill period exceeds 6 days)

11. Prepare the diesel engine for starting in compliance with Sub-Section "Preparing the Diesel Engine for Starting During Daily Operation", start the engine from the emergency control station, run it at low speed during 10 minutes and make sure that:

- (a) no abnormal noise and knocking are heard during engine operation;
- (b) no oil, water, fuel and air leak through the pipelines and engine;
- (c) the air pipes of the working cylinder starting valves do not get heated;
- (d) the readings of measuring instruments correspond to the engine parameters during operation at low r.p.m.

12. Stop the diesel engine, change over the engine control from the emergency control station to the remote control panel. Start the engine from the remote control panel.

After the engine is stopped, set and lock the handles of the emergency control station, remote control panel, and speed governor in position STOP.

INSPECTION No.3

(Carried out after each cruise)

13. Eliminate all the faults noticed in the operation of the diesel engine and its auxiliary systems during cruise.

14. Wash the fuel filters (at least every 300 to 500 hours of engine operation).

Note. When washing the filters, run the engine at low r.p.m.

15. Uncover two handholes on each row of diesel engine (one handhole in the upper covering, and the other in the lower crankcase, at random), check locking and tightening of nuts on studs and bolts of crankpin bearings, on the mounts and jacks of the lower main bearings, and on the bolts that fasten the exhaust manifold sections. Hammer the fastenings, where accessible, and make sure that they are intact. Alternate the opening of the handholes after each cruise.

16. Add lubricant;

- (a) into the main starting valves (10 drops of oil into each).

152

50X1-HUM

50X1-HUM

(b) into the lubricators of the oil seals of the water and oil thermoregulators.

17. If necessary, add oil into the speed governor (up to the centre mark of the oil level indicator) and into the reduction gear of the shaft harring arrangement.

18. Examine the filtering cartridges of the oil filter fitted in the scavenging pipeline of the lubricating system. Screw the drain plugs out of the oil and fuel filters and oil cooler, and check to see that the oil and fuel contain no water.

19. Clean the sea water filter.

20. Clean the oil separator of deposits, and change oil in the separator reduction gear (within the terms specified in the separator maintenance instructions).

INSPECTION No.4

(Carried out every 500 hours of engine operation)

21. Check fastening of the diesel engine to the foundation, inspect the shock absorbers and clean them of oil and dirt.

22. Examine and clean the oil filters in the delivery and scavenging pipelines of the oil system.

23. Remove the injectors, clean them of carbon, check quality of fuel atomizing, and check also the needle valve opening pressure. In case the quality of atomization is bad, adjust the injectors in accordance with directions laid down in Section "Fuel Injection Equipment" of Chapter V. Adjust the needle valve opening pressure, if low, and fit the injectors into place.

24. Pull the handwheel to check free travel of the safety inspection covers (at least once a month).

25. Detach the handhole covers and inspect the inner cavities of the receiver and exhaust manifolds; check condition of working cylinder sleeve face and piston rings. Clean the receiver of dirt and deposit, remove carbon from the screens of the gas exhaust manifold side branch pipes, clean the accessible portions of exhaust manifold sections, cylinder sleeve exhaust ports, and the thermocouple pipe unions.

26. Overhaul and clean the reducers of the control and thermoregulating systems (at least once a month). Scavenge the paper filtering plates and the screen of the control system air filter pipe by means of compressed air.

27. Lubricate the setter rod guides, valves and slide valves of the control panel with 3 - 5 drops of clean oil. Carry out lubrication through the relieving holes or via the unions for the air pipes. Lubricate the control selector switch rear cover the same way (but at least once a month).

28. Disassemble and wash the emergency control station starting valve and the control air system (30 kgf/cm^2) filter, then assemble them again.

29. Check sealing of the main starting valves, for which purpose close their check valves and open the starting air pipeline valve. Sealing of the main starting valve is determined by absence of air leakage through the bleeding holes made in the main starting valve bodies.

30. Check the joints of the control and starting systems for proper sealing by means of air at a pressure of 30 kgf/cm^2 .

31. Replace the protectors of the oil, water and air coolers (at least once every three months).

32. Check condition of gaskets placed under the handhole covers and coverings, and fit all the formerly detached covers and coverings into place.

33. Prepare the diesel engine for starting in compliance with the directions given in Sub-Section "Preparing the Diesel Engine for Starting During Daily Operation", start it from the emergency control station, run the warmed up engine at low speed and check operation of the overspeed governor.

183

50X1-HUM

50X1-HUM

To carry out the check, operate the engine from the emergency control station, shift the control station handle quickly towards the acceleration of engine speed until the overspeed governor operates, which should take place at a speed of 950 to 980 r.p.m., as read by the standard electric tachometer. Check the control panel in accordance with the directions given in Appendix 2.

INSPECTION No.5

(Carried out every 1,000 hours of engine operation)

34. Carry out all operations prescribed for inspection No.4.
35. Run the diesel engine, and at the same time change the water in the cooling system and wash the expansion tank, as described in Appendix 19.
37. Pressure-test the oil coolers (at least once a year).
38. Wash the oil, water and air coolers, as indicated in Appendix 12.
39. Wash the oil separator of the crankcase ventilation system.
40. Change oil in the diesel engine circulating system and clean herein the circulating tank.
41. Clean the fuel service tank.
42. Remove oil deposits from the flow part of the supercharger; measure the rotor axial play in the supporting-and-thrust bearing of the turbo-supercharger.
43. Wash the speed governor and the shaft barring arrangement reduction gear, and change the oil in them (use grade MK-22 or MC-20, GOST 1013-49, for the governor, and summer grade automobile oil, GOST 542-50, for the shaft barring arrangement reduction gear).
44. Wash the control system ceramic air filters. Inspect, clean and dry the paper plates of the control system air filter.
45. Check condition (through the handholes) of the oil pump gear.
46. Disassemble, wash, and then assemble (at least once a year) the air distributors, control selector switch and main starting valves. Make sure that the slide valves close-fit the air distributor drums, and check sealing of main starting valves and starting valves of working cylinders; lap them, if necessary. After all the parts are assembled, check the starting system in accordance with the directions given in Sub-Section "A" of Chapter VI.
47. Change lubricant in the lubricators available in the oil seals of the pneumatic regulating slide valves of the water and oil thermoregulators, and overhaul the oil seals (at least once a year).
48. Trim the contacts of electromagnetic relays in the signal panel and signal box, and check operation of the temperature and pressure sensors of the warning signalling system.

INSPECTION No.6

(Carried out every 2,000 hours of engine operation)

49. Perform all operations specified for Inspection No.5.
50. Use reference points and a straight edge with a length of at least 3 meters to check the lower bearing surfaces of diesel engine lugs for straightness. Put not less than 7 reference points. The maximum deflection of the frame on the shock absorbers is allowed up to 0.12 mm. If necessary, vary the thickness of adjusting shims placed under the shock absorbers.

151

50X1-HUM

50X1-HUM

51. Detach the upper covering and the side coverings at the lower crankcase. Measure the clearances in the bearings of the upper and lower crankshafts. Remove the upper crankshafts. Disassemble the lower crankshaft main bearings. Check condition of shaft journals and crankpins, as well as of the bushes of main and crankpin bearings.

Take out the scavenging and exhaust pistons, and remove the piston rings. Clean carbon from pistons, piston rings, cylinder sleeves (combustion chamber zone, scavenging and exhaust ports), and from the exhaust manifold sections. Clean and wash the receiver. Remove, clean and wash the side branch pipes of the gas exhaust flow path. Remove carbon from the accessible sections of the turbo-supercharger guide vane assembly. Examine and measure the piston rings; replace the defective and worn rings. Replace the top (chrome-plated) rings regardless of their condition.

52. Disassemble the pistons, check condition of the connecting rods, end bearings, piston pins and piston inserts.

53. Check condition of the fuel injection pump tappet rollers, cam plates, camshaft drive planetary mechanisms, and overspeed governor (without disassembling the units); make sure that the fuel injection pumps and high-pressure pipes are secured reliably to the engine frame.

54. Inspect the end face seal of the fresh and sea water pumps. Replace the seal by a new one, if the projection of the graphite ring is lower than 1 mm.

Each time before assembling the overhauled end face seal, lap the working surfaces of the graphite and steel rings (See Sub-Section "Overhauling the Seals of Fresh and Sea Water Pumps" of Chapter V).

55. Lubricate the ball bearings of the shafts and remote control mechanisms with solid oil, GOST 1033-51, or with petrolatum, GOST 782-59. Apply clean oil to the hinge joints of the panel parts.

56. Check condition (through the handholes) of main drive gears and the 2nd stage gears of the major accessories drive.

57. Disassemble, wash, and then assemble the fuel feed stop and the shaft barring arrangement interlocking slide valve.

58. Assemble the diesel engine, water-test it at a pressure of 1.5 kgf/cm^2 , and make sure that no water is leaking.

59. Prepare the engine for starting, as indicated in Sub-Section "Preparing the Diesel Engine for Starting During Daily Operation".

60. Adjust and run-in the diesel engine in compliance with directions given in Sub-Section "Running-In and Adjusting the Diesel Engine" of Chapter VI.

INSPECTION No.7

(Carried out every 4,000 hours of engine operation.)

61. Perform all operations pertaining to Inspection No.6.

62. Remove all the fuel injection pumps, disassemble them, check condition of parts, replace the worn parts, assemble the pumps, and adjust them for uniformly timed fuel feed on a special stand.

63. Carry out complete disassembly of the turbo-supercharger with simultaneous fault-detection of parts and the necessary measurements specified in the Service Log.

155

50X1-HUM

50X1-HUM

64. Press the working cylinder sleeves out and remove the gas exhaust manifold sections; clean them of carbon and deposits. Check condition of the centring collars of the frame, jackets and cylinder sleeves, and measure the collars.

Renew the lead plating on the centring collars of the cylinder sleeve jackets where the layer of lead has been completely worn out, and also in case the clearances on the dia. 315 mm and dia. 318 mm collars are above 0.12 mm.

65. Replace the rubber sealing rings on the cylinder sleeves and in the seals of the gas exhaust manifold sections.

66. Assemble the diesel engine, adjust it and run it in, as indicated in Sub-Section "Running-In and Adjusting the Diesel Engine" of Chapter VI.

INSPECTION No. 8

(Carried out every 12,000 hours of engine operation)

67. Carry out complete disassembly, inspection, fault-detection and micrometric measurement of diesel engine parts, units and systems. Proceeding from the results of fault-detection and micrometric measurement, determine the volume of diesel engine repairs.

Note. When carrying out inspections scheduled for every 2,000, 4,000 and 12,000 hours of operation, make detailed entries about the results of inspection and measurement into the respective Sections of the engine Service Log.

156

50X1-HUM

50X1-HUM

Chapter V

DISASSEMBLY, INSPECTION, REPLACEMENT AND ASSEMBLY OF DIESEL ENGINE PARTS AND UNITS

GENERAL

1. Do not disassemble properly functioning units or mechanisms unless necessary.
2. Before starting the disassembly procedure, prepare the necessary hoisting means in accordance with the weights of the units to be disassembled; select and prepare the required tools and appliances (the sketches of tools and appliances are presented in Appendix 18). See that the tools and appliances delivered with the diesel engine are used in compliance with their direct purpose, and never use worn or damaged tools.
3. Prior to disassembling the outer joints, wash the diesel engine thoroughly until dirt is completely removed, then wipe the outer surfaces of the unit to be disassembled, as well as the adjacent surfaces, with clean cotton cloth until dry.
4. When disassembling, take measures to prevent entrance of dirt and foreign matter into the inner cavities of the diesel engine and of the units disassembled. After the units or parts are removed, inspect their attachment places and close the latter with blind veneer, paronite or cardboard spacers. Wrap the flanges and unions of the disconnected pipes of the engine fuel, oil, air and water systems in dense oil-paper (parchment) and bind them over. As soon as a part or unit is detached, fit the removed fastenings into place, or put them into a separate box.
5. Before disassembling the bearings, gears and other movable joints, measure the clearances.
6. During the disassembly of units make sure that the marking (see Appendix 8) is intact, and pay attention to see that match-marks are available on the mating parts (if no match-marks are seen, make them anew). When assembling the units, pay attention to the location of the marking or match-marks, so as to mount the parts properly in their initial position.
7. Take measures to ensure safety of the removed parts and to protect them against damage. Wash all the removed parts with clean diesel fuel, wipe them dry by means of clean cloth, or blow them out with compressed air. Coat the part ground surfaces with a thin layer of clean oil used for lubricating the diesel engine. If the work is interrupted for some period, cover the parts with dense oil-paper (parchment) or with clean tarpaulin.
8. Screw the studs out of their seats only in cases when the studs are to be replaced, or if the part into which the studs are screwed needs repairs or replacement.

157

50X1-HUM

50X1-HUM

9. To disassemble interference-fitted joints, use only special tools; if no special tools have been assigned for this particular case, use copper, aluminium or wooden drifts.

10. Right before assembling and mounting the parts on the diesel engine, clean them of dirt and corrosion-preventive lubricant, wash them with clean diesel fuel and blow out with compressed air. Inspect all passages, lubricating and threaded holes thoroughly, and scavenge them with compressed air; lubricate the part friction surfaces with clean oil used for lubricating the diesel engine.

Remove burrs, nicks, fine scores, etc., by filling or scraping. Wash the corrected parts again.

11. During the assembly procedure lubricate all the threaded joints with clean oil used for lubricating the diesel engine; an exception to this is the thread of studs and nuts that fasten the mounts, connecting rod blades and connecting rod bolts; these joints are to be lubricated with castor oil. Apply fine flaky graphite to the threaded joints subject to high temperatures.

The bolts and the nuts of the studs that fasten the unit or part are to be tightened up gradually and uniformly; never tighten up the adjacent nuts completely one after the other.

12. Do not re-use the locking tab washers, strips and cotter pins. Fit the cotter pins into the stud and bolt holes so that they are not loose and that they do not project above the nut slot.

13. Before installing the next part or unit, check tightening or forelocking of the nuts or bolts which fasten the parts or units already installed.

14. Carry out disassembly of fuel injection equipment, speed governor, valves and slide valves of the starting system, remote control panel and thermoregulator control units in specially assigned places, and use separate clean tanks with filtered diesel fuel for washing the precision couples and other parts.

To ensure more thorough removal of dirt from the precision couples, wash them successively in two tanks.

15. Disassemble and assemble the diesel engine, as well as its separate units and parts, in a closed room with a temperature not lower than 10°C above zero, and take measures to protect the parts and the disassembly sites against entrance of dust, dirt or water.

16. Enter the results of inspections and checks into the Log Book. All cases of replacement and measurement of parts must be entered into the diesel engine Service Log.

17. In case the main propelling units and parts have been replaced, run-in the diesel engine in accordance with the directions given in Chapter VI.

MAIN BEARINGS

18. Take out the half-bushes of the main bearings of the upper and lower crankshafts (if the latter have not been removed) successively through every other bearing.

To take out the half-bushes of the lower crankshaft main bearings, proceed as follows:

(a) remove the bearing cap jack, for which purpose uncotter the locknut, unscrew it by means of wrench 47B -232-035-1, then drive the screw into the jack nut;

(b) detach the bearing cap together with the upper half-bush;

(c) move the lower half-bush out of the bearing mount bed. To this end, fit appliance 47B -232-189 on the crankshaft main journal by inserting the appliance pin into the main journal hole, then turn the crankshaft and move the half-bush out of the mount. Turn herein the crankshaft in such a way that the half-bush lock comes out of the mount upwards.

50X1-HUM

50X1-HUM

When disassembling the locating bearing, do the following:

- (a) take out the stern bearing cap together with the upper thrust half-rings, when the adjacent crank of this particular crankshaft is in the bottom dead centre;
- (b) when removing the lower thrust half-ring located on the side of the turbo-supercharger, prepare a temporary half-ring beforehand, and fit it instead of the removed one; the temporary half-ring should not be thinner than the removed one.

19. To take out the half-bushes of the upper crankshaft bearings, proceed as follows:

- (a) remove the mount complete with the upper half-bush, for which purpose uncotter the nuts of the mount fastening studs and unscrew the nuts by means of wrench 47B - 232-498. Lift the mount by eye-bolt M12 x 1.75;
 - (b) move the lower half-bush out of the bed, as indicated in Para.18c for the lower crankshaft.
- During the disassembly of the locating bearing, do the following:
- (a) when lifting the mount, hold the upper thrust half-rings with your hands;
 - (b) when removing the lower thrust half-ring located on the side of the turbo-supercharger, prepare a temporary half-ring beforehand, and fit it instead of the removed one; the temporary half-ring should not be thinner than the removed one.

20. The half-bushes are to be replaced in the following cases:

- (a) pitting in the form of cavities is formed all over the working surface of the half-bush;
- (b) the lined sections are chipped, and visible cracks are detected on the working surface;
- (c) scores and local wear are detected on the working surface, provided visible cracks are formed;
- (d) traces of cold working are detected on the half-bush surface contacting the bed.

21. When replacing the separate working half-bushes, take care to see that the thickness of the newly installed half-bushes does not differ from the thickness of the replaced half-bushes by more than ± 0.01 mm (the thickness of the half-bush is to be measured in the central part of the half-bush).

CAUTION. Never scrape the working surface of half-bushes lined with leaden bronze. Reproduce the marking of the removed half-bush on the new one by punching 3-mm figures.

22. In case the oil clearance in separate main bearings increases up to the maximum permissible value of 0.40 mm, it is advisable to replace all the working half-bushes of this crankshaft.

23. The half-rings of the thrust bearings are to be replaced if cracks or chipping are found on the working surface, and also if the crankshaft axial play increases by more than 0.8 mm.

24. The bushes of the lower crankshaft main bearings are to be mounted in the following sequence:

- (a) examine the finished surfaces of bearing caps to make sure that they are free of nicks and notches. Wipe the beds in the caps and the engine frame mounts, wipe the crankshaft main journal and lubricate it with clean oil;
- (b) check marking of the half-bushes to make sure that they pertain to this particular bearing. The marking is punched with 3 mm high figures on the end face surface at the joint face of the half-bushes on the side of the turbo-supercharger;
- (c) fit appliance 47B - 232-189 as far as it will go into the journal hole, crank the diesel engine and arrange the crankshaft in such a position in which the appliance disappears in the clearance between the bed and the shaft journal;

159
50X1-HUM

50X1-HUM

(d) apply a thin layer of oil to the working surface of the lower half-bush and arrange the latter on the shaft main journal so that the half-bush lock is on the opposite side, relative to the slot made in the mount;

(e) fit appliance 47A-232-034 on the half-bush and secure it by means of the jack;

(f) turn the crankshafts with the aid of the shaft barring arrangement and move the half-bush into the bed of the mount. Turn herein the crankshafts in such a way that appliance 47B-232-189 rests against the end face surface of the half-bush on the side of the lock during rotation of crankshafts;

(g) take the appliance out and check whether the half-bush lock is aligned with the mount slot;

(h) attach the bearing cap together with the upper half-bush, mount the jack, then tighten up and forelock the jack screw and locknut.

Tighten up the screw and locknut with a force applied by one man to wrench 47B-232-035-1 provided with a 500 mm long handle.

When assembling the locating bearing of the lower crankshaft, do the following:

(a) fit the lower thrust half-rings into the grooves of the lower mount;

(b) put the upper half-bush into the bearing cap;

(c) insert the upper thrust half-rings into the bearing cap and secure them on the cap pins;

(d) set the adjacent crank of this particular crankshaft in the bottom dead centre;

(e) hold the upper thrust half-rings with your hands, and fit the cap into place.

25. In case the upper crankshafts have not been removed, mount the lower half-bushes of the upper crankshaft main bearings in the same way as the main half-bushes of the lower crankshafts, but with the following peculiarities:

Do not fit appliance 47A-232-034, and when turning the crankshaft with the aim of fitting the lower half-bush into the frame bed, press the half-bush to the shaft journal by hand.

To assemble the locating bearing of the upper crankshaft, proceed as follows:

(a) fit the lower thrust half-rings into the grooves of the upper frame;

(b) place the upper half-bush into the mount;

(c) insert the upper thrust half-rings into the mount grooves and secure them on the pins;

(d) hold the upper thrust rings with your hands, and fit the mount into place.

26. Having fitted the mount with the upper half-bush into place, tighten up the nuts of the mount fastening studs by hand with the aid of wrench 47B-232-498 until the torque on the wrench handle grows abruptly, after which tighten up the nuts through one and a half facet more. The nuts are to be tightened up alternately in two or three motions by knocking against the wrench handle.

Before screwing the nuts on, apply castor oil to the thread of the nuts and studs.

When tightening up the mounts and jacks, check proper centering of the bush in the mount by the difference in the clearances between the bush and the shaft, and between the bed and the bush. The difference between clearances "bow" - "stern" within one bush should not exceed 0.03 mm.

27. After the main bearings are assembled, check the clearances in the overhauled bearings, and also in the two adjacent main bearings.

28. Having replaced the half-bushes of four and more main bearings, and having arranged the upper crankshaft, check the clearances lengthwise this particular shaft line.

100

50X1-HUM

50X1-HUM

29. The main bearing clearances measured by means of a feeler gauge must be as follows:

(a) oil clearance - within the values specified in the table of mounting and operation clearances.

The difference in clearances on the side of the main drive and on the side of the turbo-supercharger should not exceed 0.05 mm for all main bearings;

(b) a 0.03-mm thick feeler gauge should not pass at the half-bush joints and also between the half-bush and the bed;

(c) the clearance under the shaft at separate bearings (for lower crankshafts only) is permissible up to 0.03 mm;

(d) the side radial clearances (at the joints) at a distance of 30 mm from the joint face must be as follows:

- 0.07 to 0.30 mm - for half-bushes located above the joint face;

- 0.05 to 0.25 mm - for half-bushes located below the joint face.

The difference between the largest and smallest side clearances for all the bearings on one side of the shaft, in each of the two horizontal planes (above and below the joint face) should herein not exceed 0.07 mm, while for one bearing the difference between respective clearances "bow" - "stern" must not be in excess of 0.03 mm.

30. See that the axial play of crankshafts in the thrust bearings is within the values indicated in the table of mounting and operation clearances.

31. After running-in of diesel engine is accomplished, repeat the checking of clearances in the bearings with replaced working half-bushes, and also in the adjacent bearings.

UPPER CRANKSHAFTS

32. To remove the upper crankshafts, proceed as follows:

(a) remove the diesel engine upper covering. To this end, disconnect the crankshaft ventilation pipe (together with the oil separator), undo the bolts which fasten the covering flanges, then remove the covering by means of the wire rope secured in its lugs;

(b) detach the control rods and remove the covers of camshaft drive planetary mechanism handholes. The overspeed governor operating mechanism must be set herein in its working position;

(c) check mutual location of diesel engine crankshafts and camshafts according to the match-marks.

To check mutual location of the crankshafts, arrange the first cylinder crank in the inner dead center, in compliance with the graduation available on the splined coupling of the starboard lower crankshaft.

Take up backlash in the teeth of main drive gears by turning the diesel engine with the aid of the shaft barring arrangement in the ASTERN direction. With this position of the starboard lower crankshaft, the match-marks made on the splined couplings of the upper crankshafts must be horizontal and should align with the upper surface of diesel engine frame.

Mutual location of the camshafts and crankshafts is to be checked as follows: turn the diesel engine in direction ASTERN and set the cranks of the 1st and 14th cylinders alternately in the inner dead center, in compliance with the graduation available on the splined couplings of the lower crankshafts.

161
50X1-HUM

50X1-HUM

The match-marks made on the side surface of the carrier lug must align in this case with the match-marks made on the end face surface of the crown of the camshaft drive planetary mechanism driving gear;

(d) disassemble the crankpin bearings, for which purpose remove the cotter pins alternately from each connecting rod, unscrew the nut by means of wrench 47Д-232-076, and take out one connecting rod bolt.

Hold the connecting rod with the piston by means of a hooked wire rope passed into the connecting rod bolt hole, undo the nuts and take out the remaining three connecting rod bolts.

Remove the connecting rod big end cap together with the half-bush.

Lower the piston down into the cylinder and mount the connecting rod big end carefully on the end face of the working cylinder sleeve;

(e) disassemble the main bearings. To this end, remove the cotter pins, screw the nuts off the mount holding studs with the aid of wrench 47Б-232-498, and remove the mounts complete with the upper half-bushes (lift the mount by eye-bolt M12 x 1.75);

(f) screw out the thrust bearing lower half-rings;

(g) disconnect the speed control servo-motor from the speed governor and remove the end face covers of the main drive gear bearings;

(h) disengage the intermediate shaft from the crankshaft splined coupling by means of appliance 47Д-232-081; when using the appliance, suspend it from the shackle;

(i) fit supports 47Б-232-016 on the frame upper shelf against the 2nd and 7th main journals, and mount clamp 47Б-232-185 on the crankshaft 2nd and 6th crankpins;

(j) lift the crankshaft by the 2nd and 6th crankpins and place it on supports 47Б-232-016.

33. When inspecting the crankshafts, do the following:

(a) wash the crankshaft outer surfaces and oil passages with diesel fuel and scavenge them with compressed air. Wipe the outer surfaces until dry;

(b) inspect the crankpins, main journals and crank webs thoroughly through a 4-power magnifying glass.

Remove the detected notches, scratches and nicks by polishing;

(c) check condition of working surfaces of the coupling and intermediate shaft splines; file-clean the detected notches and nicks;

(d) check whether the fastenings of the coupling, damper, and of the journal and crankpin plugs are locked reliably;

(e) coat the journals and crankpins with oil and wrap them in water-proof paper.

34. To mount the upper crankshafts, proceed as follows:

(a) insert the upper pistons into the cylinders;

(b) place the main bearing lower half-bushes into the frame beds according to the marking, and fit the upper half-bushes into the beds of the mounts; pay attention to see that the bush lug aligns with the mount recess, then apply clean oil to the working surface of the bushes and to the main journals;

(c) place the crankshaft onto the lower bushes so that the shaft coupling teeth come into mesh with the teeth of the planetary mechanism driving gear.

(d) insert the thrust bearing lower half-rings into the beds according to the marking;

(e) install the mounts with the half-bushes into the engine frame in compliance with the marking;

162

50X1-HUM

50X1-HUM

(f) coat the thread of the mount studs and nuts with oil used for lubricating the diesel engine, then assemble the main bearings;

(g) insert the thrust bearing mount by fitting thrust half-rings on the pins of the mount side surfaces; when inserting the mount, keep the half-rings against falling out.

Check the thrust bearing oil clearance with the aid of an indicator held to the frame by means of a bracket; the indicator stand should rest against the damper surface. Shift the shaft to the extreme position by means of a crowbar, then return it back and determine the shaft axial play;

(h) suspend the upper pistons, assemble the connecting rod big ends on the crankpins;

(i) use appliance 47Д - 232-081

to connect the crankshaft

coupling to the main drive gear coupling by means of the intermediate shaft. Carry out mounting in accordance with the marks. Marks "O" made on the end faces of the splines of the intermediate shaft and main drive gear coupling must form a triangle at the meshing (Figs 76, 77);

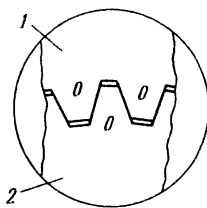


FIG. 76
1 - coupling; 2 - shaft

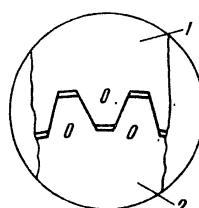


FIG. 77
1 - coupling; 2 - shaft

(j) check mutual location of crankshafts and camshafts in compliance with the match-marks;

(k) check the compression chamber height in all cylinders. If the pistons have not been removed, check the compression chamber height by means of pressed-out lead in two cylinders only. See that the compression chamber height corresponds to the value specified in the diesel engine Service Log for these cylinders;

(l) check the fuel injection advance angles;

(m) fit the limiting ring on the cover of the main drive upper gear, and cover the end faces of the torsion shafts;

(n) connect the speed control servo-motor to the governor and the air pipeline;

(o) close the covers of the planetary mechanism handholes;

(p) attach the diesel engine upper covering.

CONNECTING-ROD-AND-PISTON ASSEMBLY

35. Dismount the connecting-rod-and-piston assembly through the lower crankcase side hatch in the following sequence:

(a) remove the covering of the lower crankcase side hatch;

(b) arrange the crankpin bearing of the cylinder to be disassembled in a position convenient for disassembly;

(c) unlock the nuts of the studs which hold the connecting rod pivot to the big end, after which unscrew the nuts first by means of splined wrench 47Б - 232-304, and then with the aid of wrench 47В-232-303;

50X1-HUM

50X1-HUM

(d) mount appliance 47Д - 232-049. Used for removing the piston through the lower crankcase inside the lower crankcase. To this end, secure winch 47Д - 232-060 by means of studs between the hatches of the side coverings; fasten grip 47Д - 232-053 to the connecting rod blade, near the pivot. Pass the wire rope over pulleys 47Д - 232-021 and 47Д - 232-019 mounted in the seats on the inner side of the lower crankcase upper shell, and secure the rope ends to the winch and the grip;

(e) arrange the crank of the said piston in horizontal position towards the hatch.

In this position tighten the winch rope and suspend the piston. Make the crankshafts turn by jerks and move the big end studs gradually out of the connecting rod pivot holes; at the same time, hammer slightly against the connecting rod blade and the big end, to prevent misalignment of the surfaces of the connecting rod pivot and the big end;

(f) keep the piston with the connecting rod suspended and make the crankshaft turn so that the crankpin lowers down, then overruns the horizontal position by 10 to 15° and stops inside the diesel engine;

(g) install carriage 47Д - 232-500 on the web surfaces and the hatch lower edge. Lower trough 47Д - 232-262-1 down between the carriage slides and secure it to the hatch edge;

(h) slacken the rope with the aid of the winch and lower the piston down in such a way that the connecting rod passes into the crankcase between the carriage, while the piston trunk lower end face rests on the carriage;

(i) turn the crankshaft until a clearance is formed between the upper end face of the trunk and the lower end face of the sleeve;

(j) move the piston with the connecting rod along the carriage towards the hatch, incline it to yourself and take it out of the crankcase by means of lifting fixture 47Д - 232-083;

(k) remove carriage 47Д - 232-500 and trough 47Д - 232-262-1. If no provision is made for removing the upper piston through the lower crankcase hatch, fit protective rod 47Д - 232-090 so as to prevent the studs that hold the big end to the connecting rod blade from being damaged during rotation of the crankshafts.

36. Dismounting of the upper connecting-rod-and-piston assembly may be carried out in two ways:

(a) through the lower crankcase, after the respective lower connecting-rod-and-piston assembly has been taken out;

(b) through the upper crankcase, after the upper crankshaft has been removed.

Removal of upper connecting-rod-and-piston assemblies through the lower crankcase without removing the upper crankshaft is done in cases when it is necessary to take out not more than four upper connecting-rod-and-piston assemblies.

37. To take out the upper piston through the lower crankcase, do the following:

(a) take out the respective piston and the big end through the lower crankcase;

(b) clean the sleeve combustion chamber belt thoroughly by means of a scraper, and then wipe it with cloth soaked in solvent;

(c) unlock and release the nuts which fasten the connecting rod pivot to the big end;

(d) sling the piston with the connecting rod by the connecting rod pivot, and disconnect the big end from the connecting rod.

104

50X1-HUM

50X1-HUM

(e) turn the crankshafts until they occupy a position in which the respective crankpins of the lower crankshafts face the side hatches;

(f) lower the piston with the connecting rod down into the sump between the crankshafts;

(g) take the piston with the connecting rod out of the lower crankcase by hand.

38. To take out the upper piston through the upper crankcase, proceed as follows:

(a) remove the upper covering;

(b) remove the upper crankshaft;

(c) sling the piston with the connecting rod lowered down into the cylinder so that the big end rests against the sleeve end face by the big end and take the piston out of the cylinder.

39. To remove the big end, unlock the connecting rod bolt nuts, then screw them off by means of wrenches 47 Д -232-074 and 47 Д -232-076. Hold up the big end and the cap and take out the connecting rod bolts. Remove the big end and the cap together with the half-bushes from the shaft crankpin.

40. Disassembly of the piston is done as follows:

(a) suspend the connecting-rod-and-piston assembly by the connecting rod, remove the piston rings by means of remover 61 Б -232-039, clean the piston rings thoroughly of carbon, then supply each ring with a tag indicating the piston and the groove to which this particular ring pertains;

(b) lower the connecting rod-and-piston assembly down onto the trunk head;

(c) unlock the insert-to-trunk fastening studs and screw them off by means of wrench 47 Д -232-072; remove the drain pipe and the blank plug;

(d) take the connecting rod with the insert out of the piston trunk. When taking the connecting rod out, tap the piston trunk edge lightly with a lead hammer (do not knock against the end faces of the insert fastening studs);

(e) press the piston pin out of the insert with the aid of remover 47 Б -232-194;

(f) tie the drain pipe, plug and slipper with spring together, and attach a tag indicating the disassembled piston to which they pertain;

(g) clean the piston surface of carbon and wash it with clean diesel fuel; to clean the pistons, follow the special instructions (see Appendix 11).

41. Replace the piston parts if they have the following faults:

(a) trunk - scores or cracks;

(b) insert - cracks;

(c) slipper - scores;

(d) piston pin - cracks and ovality above 0.1 mm.

If separate notches and scores are detected, polish them.

42. The connecting rod parts are to be replaced in the following cases:

(a) connecting rod blade - if cracks or curvature are noticed;

(b) crank bolts - in case the collars are scored or the thread is damaged;

(c) crankpin bushes - in case they have the same faults as indicated above for main bushes;

(d) connecting rod small end bush - if the working surface is scored, or the clearance between the bush and the pin is above the value specified in the table of clearances.

In case nicks are found on the spherical surface of the connecting rod small end, clean the surface and lap the piston slipper to the connecting rod end.

50X1-HUM

50X1-HUM

43. Replace the compression and protective rings in the following cases:
- (a) breakage of a ring;
 - (b) loss of elasticity;
 - (c) separation of the bronze collar;
 - (d) if the piston ring free or compressed gaps are beyond the values permissible by the table of clearances;
 - (e) when replacing the cylinder sleeve;
 - (f) if gas escape sections are found on the ring working surface;
 - (g) in case the ring wears locally down so that its thickness is 7 mm, or if pointed burrs are formed on the ring edges;
 - (h) if the chrome plating gets separated or worn at the ring joint within a section longer than 10 mm.

Replace the oil-control rings in cases when the following faults are detected:

- (a) breakage of ring, or chipping of its working face;
- (b) wear of ring working face, due to which the working face width increases above 1.2 mm.

44. When assembling the piston with the connecting rod, fit the parts into their places in compliance with the following directions:

- (a) make sure that the marking put on the insert, connecting rod, trunk and piston pin end face to indicate their belonging to this particular piston faces the turbo-supercharger. Before pressing in the piston pin, heat the piston insert in oil up to a temperature of 50 to 80°C;
- (b) fit the insert complete with the connecting rod into the piston so that the hole available in the insert end face is aligned with the locating pin of the trunk head;
- (c) attach the drain pipe to the insert on the side of the marking, and fit the plug on the opposite side;

- (d) screw on the insert fastening nuts as far as they will go by means of wrench 47Д - 232-072 with a force applied by one hand to a 500 mm long arm, then tighten them up through 2 to 2.5 facets in two or three motions (alternate the tightening-up of nuts located along a diagonal line);

(e) the pistons and connecting rods are to be replaced in a complete set.

During replacement of piston, connecting rod, or their parts, check the following:

- weights of the sets of piston and piston with connecting rod; the weights must correspond to the weights of pistons and pistons with connecting rods installed in this particular diesel engine (see Service Log). Ensure proper weight of the set by selecting the parts of required weight;
- perpendicular misalignment of the piston pin axis with the trunk generatrix, which should not exceed 0.2 mm per meter;
- parallel misalignment of the piston pin axis with the connecting rod big end bore axis, which should not be above 0.15 mm per meter;
- measured clearance between the insert and the trunk along the upper centring collar (at the bearing surface of the insert and the trunk); the clearance along the upper centring collar must be within 0.02 to 0.10 mm, while along the lower centring collar it must be within 0.06 to 0.15 mm;
- measured clearance between the end bearing bushing and the piston pin, which should be within the values specified by the table of operation clearances;
- measured fit of the piston pin in insert lugs; the fit must be from a clearance of 0.05 mm to a negative allowance of 0.005 mm;

166

50X1-HUM

50X1-HUM

- ovality of the surface of piston assembly, which should not exceed 0.1 mm;
- measured negative allowance of end bearing bushing in connecting rod lug; the negative allowance is permissible within 0.015 - 0.045 mm.

To press the bushing out, use puller 47 B - 232-049-1. The negative allowance is to be measured only during replacement of end bushing.

Notes: 1. The spare bushings of the connecting rod end bearings fall into two groups differing in the size of the outer diameter;

group B - with an outer diameter of 115 $+0.060$
 $+0.045$

group C - with an outer diameter of 115 $+0.075$
 $+0.060$

2. If the negative allowance is below the ranges specified above, press bushings of group B into connecting rods of group A, while bushings of group C must be pressed into connecting rods of group B;

(f) when replacing the half-bushes of crankpin bearings, make sure that no clearance is formed between the half-bushes and the crankpin end beds with the bearing upset (a 0.03 mm thick feeler gauge should not pass into the joint of half-bushes);

(g) during replacement of big end studs, take care to see that the stud group numbers (I and II) correspond to similar groups of threaded holes made in the big end;

(h) when replacing the piston rings, make sure that the piston ring compressed gap and the clearance in the piston groove correspond to the values indicated in the table of clearances. In case sharp edges are found on the outer surfaces of compression and protective rings fit for further service, blunt the edges;

(i) when replacing the insert, trunk, or connecting rod blade in both sets of one of the cylinders, measure the actual length of the connecting rods complete with pistons, so that it is possible to determine the thickness of the compression plates from the following formulas:

$$T_u = 849.3 - A_u; \quad T_l = 999.1 - A_l,$$

where T_u and T_l - thickness of compression plates of upper and lower connecting rods, respectively;

A_u and A_l - actual length of upper and lower connecting rods complete with pistons (from the piston upper end face to the big end axis).

To measure value A, assemble the pistons and connecting rods without compression plates and crankpin bushes;

(j) length A may not be measured when replacing the insert, trunk or connecting rod blade of one set (from the two located in the same cylinder). In this case, determine compression plate thickness T after the compression chamber height has been measured (see mounting of upper pistons), so as to obtain the value of compression chamber height specified in the diesel engine Service Log for this particular cylinder.

45. To mount the lower pistons, proceed as follows:

(a) arrange the crankpin of the lower crankshaft in a position convenient for assembling the connecting rod big end (30° after TDC, with the crank towards the handhole), then assemble the big end on the crankpin. To this end, coat the crankpin with oil used for lubricating the diesel engine, mount the big end upper half complete with the half-bush on the shaft crankpin, and fit the big end cap with the half-bush and connecting rod bolts in such a way that the bolts enter the holes of the big end upper half. Hold the cap and screw the nuts on the connecting rod bolts; watch herein to see

167

50X1-HUM

50X1-HUM

that the locking pins are in the slots made in the heads of the connecting rod bolts. The marking put on the upper half of the big end and the cap to indicate the cylinder to which they pertain must face the turbo-supercharger;

(b) lubricate the connecting rod bolt thread with oil used for lubricating the engine, screw-on the nuts as far as they will go with a force applied by one hand to wrench 47Д -232-074 provided with a 200 mm long arm, give the nuts one revolution back, after which tighten them up right home again; then tighten up the nuts alternately through one facet in two or three motions (in the crosswise sequence), after which make sure that no clearance is left in the joints between the big end and cap; a 0.03 mm thick feeler gauge should not pass;

(c) measure the clearances between the non-working half-bush and the shaft crankpin on both sides of the bearing (with the crank being in the bottom dead center). The clearances must correspond to the values indicated in the table of clearances; the difference in the clearances on both sides of the bearing should not exceed 0.03 mm.

Forelock the nuts of connecting rod bolts;

(d) fit the oil-control, protective and compression rings on the piston by means of piston ring remover and inserter 61Б -232-039. Insert two oil control rings into the first (from bottom) piston trunk groove, and fit protective rings into the second and third (from bottom) grooves.

When fitting the oil-control rings on the piston, make sure that the recesses made on the ring sides were directed to one another.

Never insert the rings with their joints through the connecting rod blade, so as to prevent breakage of the rings.

Make sure that the piston rings move freely and without jamming inside the grooves, and that the clearances between the ring and the groove are within the values indicated in the table of mounting and operation clearances (Appendix 6).

Turn the ring joints on the piston through 180° relative to each other, and arrange them along the diesel engine axis. Lubricate the rings and the trunk with oil;

(e) mount appliance 47Д -232-049-1 for inserting the piston into the cylinder;

(f) move the piston with the connecting rod through the lower crankcase hatch and fit it on carriage 47Д -232-500. Pay herein attention to see that the marking which indicates the belonging of the piston to this particular cylinder faces the turbo-supercharger, and that the recesses (for the injector spray cones) made in the trunk head are directed outside;

(g) shift the piston on the carriage under the sleeve;

(h) fit split taper ring 61Б-232-027 on the sleeve lower part;

(i) pull the piston up by means of the winch and insert it into the sleeve;

(j) turn the crankshaft with the aid of the shaft barring arrangement in a position convenient for fitting the connecting rod pivot on the big end;

(k) mount the compression plate on the big end studs;

(l) lower the connecting rod with the piston by means of the winch down onto the big end, so that the big end studs get freely into the connecting rod pivot holes without any misalignment;

(m) remove the grip, pulleys and winch;

(n) turn the crankshafts with the aid of the shaft barring arrangement until the crankpin occupies a position convenient for tightening up the nuts;

50X1-HUM

50X1-HUM

(o) use splined wrenches 47B -232-303 and 47B -232-304 to tighten up the nuts on the studs which hold the connecting rod pivot to the big end. The nuts are to be tightened up in compliance with special instructions (see Appendix 13);

(p) forelock the stud fastening nuts by means of new cotter pins.

46. Mounting of the upper connecting-rod-and-piston assembly is performed:

(a) through the lower crankcase, without removing the upper crankshaft;

(b) through the upper crankcase, with the upper crankshaft removed.

47. To mount the upper connecting-rod-and-piston assembly through the lower crankcase, do the following:

(a) fit the oil-control, compression and protective rings on the piston in accordance with the directions given above for the lower piston.

(b) assemble the big end on the respective crankpin of the upper shaft;

(c) turn the crankshafts until they occupy such a position in which the crankpins of the lower crankshafts face the side hatches. Fit split taper ring 61B-232-027 on the sleeve lower part;

(d) lower the piston with the connecting rod down into the sump between the crankshafts, so that the piston head is down;

(e) sling the connecting-rod-and-piston assembly by the connecting rod blade. Pass a wire rope through the cylinder sleeve. Lift the connecting-rod-and-piston assembly into the cylinder, but hold herein the rope, so that it does not touch the cylinder face;

(f) turn the upper crankshaft with the aid of the shaft barring arrangement until it occupies a position convenient for fitting the connecting rod on the big end studs. Fit the compression plate and connecting rod blade on the big end studs, so that alignment is observed; screw-on the nuts and remove the wire rope;

(g) use splined wrenches 47B -232-303 and 47B -232-304 to tighten up the nuts on the studs that hold the connecting rod pivot to the big end. The nuts are to be tightened up in compliance with special instructions (see Appendix 13).

48. To mount the upper connecting-rod-and-piston assemblies through the upper crankcase, proceed as follows:

(a) fit the rings on the piston, as described in Para.47a;

(b) mount taper ring 61B-232-027 used for inserting the upper piston into the cylinder on the upper end face of the cylinder sleeve;

(c) lower the connecting-rod-and-piston assembly with the big end attached to it into the cylinder. Remove the taper ring from the sleeve end face, as soon as the piston gets completely into the sleeve.

Lower the piston with the connecting rod down into the sleeve so that the big end rests against the sleeve end face. Remove the wire rope;

(d) carry out final assembly of the big end after the crankshaft is arranged into its place.

49. To arrange the upper crankshaft into its place, do the following:

(a) fit all the connecting-rod-and-piston assemblies into the cylinders, as described in Para.48.

See that the marking available on the connecting rod big ends faces the turbo-supercharger;

189

50X1-HUM

50X1-HUM

- (b) sling the crankshaft, wipe and lubricate all its crankpins and journals;
- (c) insert the half-bushes into the beds of the frame, mounts and big ends;
- (d) lower the shaft down onto the main half-bushes;
- (e) assemble the main bearings of the shaft line, as indicated in Paras 26 and 28.

50. Assemble the connecting rod big ends on the crankpins of the upper crankshaft, for which purpose do the following:

- (a) sling the connecting-rod-and-piston assembly by the connecting rod blade, hold the connecting rod with the piston by means of the wire rope, fit the connecting rod big end with the half-bush onto the shaft crankpin, and attach the big end cap with the half-bush;
- (b) insert the connecting rod bolts and upset them, as indicated for the big end of the lower connecting-rod-and-piston assembly;
- (c) measure the clearances in crankpin bearings on both sides. The values of clearances must correspond to the values indicated in the table of mounting and operation clearances. The difference in clearances on both sides of the bearing is permissible up to 0.03 mm. (When measuring the clearances, arrange the crank in its upper position);
- (d) forelock the connecting rod bolt nuts by means of new cotter pins;
- (e) measure the height of the compression chamber in all overhauled cylinders, and write down the results into the diesel engine Service Log.

51. To measure the height of the compression chamber, proceed as follows:

- (a) prepare lead pieces. To this end, take 1.0 to 1.5 mm diameter mild steel wire, clean it of scale and cut it into 280 mm long pieces according to the number of cylinders to be checked. Pass the wire ends into the holes of standard lead seals and twist them so that the distance between the seal outer edges is 210 to 215 mm;
- (b) remove the covers of the exhaust manifold handholes;
- (c) crank the diesel engine, set the upper end faces of the lower pistons alternately in level with the lower edges of the exhaust ports, pass the prepared lead pieces through the exhaust ports and place them onto the piston heads in the direction of travel;
- (d) turn the diesel engine by means of the shaft barring arrangement so that all the pistons pass their TDC and lower down into the zone of exhaust ports again;
- (e) take the lead pieces out of the cylinders, and measure the thickness of both pressed seals with the aid of a micrometer. The mean value of measurements will make up the compression chamber height.

The height of the compression chamber must be within 3.0 to 3.5 mm;

- (f) attach the covers of the exhaust manifold handholes.

WORKING CYLINDER SLEEVE

52. Removal of the working cylinder sleeve is done in the following sequence:

- (a) drain water out of the engine cooling system;
- (b) remove the respective upper crankshaft;
- (c) take the upper and lower pistons out of the cylinders;
- (d) detach the high-pressure pipes, the injectors and the starting valve with the indicator valve. Use wrench 47B -232-191 for detaching the high-pressure pipes;

170

50X1-HUM

50X1-HUM

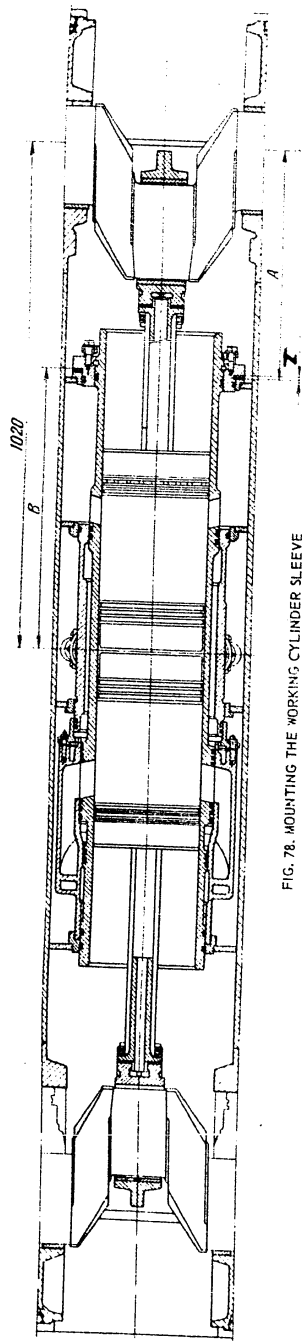


FIG. 78. MOUNTING THE WORKING CYLINDER SLEEVE

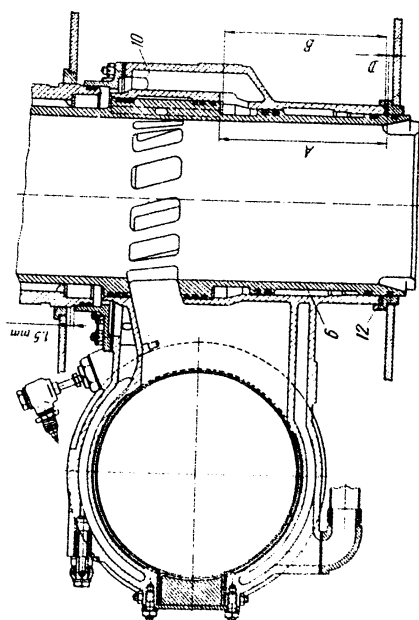


FIG. 79. MOUNTING THE EXHAUST BOX

171

50X1-HUM

50X1-HUM

(e) disassemble and remove the pipe unions for the injectors and starting valve;
 (f) detach the cooling water outlet branch pipe from the cylinder sleeve jacket, and screw out the studs;

(g) cover the lower crankshaft, the main bearings and the lower crankcase under the sleeve with tarpaulin, so as to protect them against dirt;

(h) unscrew the sleeve-to-frame holding nuts by means of wrench 47Д - 232-070.

Lock the sleeve relative to the jacket by screwing appliance 47Д - 232-095 into the hole for the starting valve pipe union. Press the working cylinder sleeve out of the frame by means of remover 47Д - 232-079; as soon as the sleeve leaves the locating collars, screw out locking appliance 47Д - 232-095. After the sleeve is pressed out, take off the adjusting shims; see that the marking put on the shims corresponds to the number of cylinder.

53. To inspect the working cylinder sleeves, proceed as follows:

(a) remove carbon from the combustion chamber belt and from the scavenging and exhaust ports;

(b) examine the cylinder sleeve face; pay particular attention to the sleeve surface near the holes for the injector and starting valve pipe unions. Replace the sleeve if scores or cracks are found on it. The cylinder sleeve diametral wear within the return of the 1st compression ring is permissible up to 0.5 mm. Ovality in the central part between the ports should not exceed 0.08 mm, while near the flange it is allowed up to 0.12 mm.

54. To mount the working cylinder sleeve, do as follows:

(a) clean the inner cavity and the locating collars of the exhaust manifold section; cover herein the main bearings, the crankpin and the lower crankcase under the manifold section with tarpaulin;

(b) furnish the sleeve with rubber sealing rings in compliance with the instructions for fitting the rings on the sleeve (see Appendix 14), and lower the sleeve down into the frame. Secure the sleeve relative to the jacket, for which purpose screw appliance 47Д - 232-095 into the hole for the starting valve pipe union; use inserter 47Д - 232-079 to press the sleeve finally into the frame; be sure to place adjusting shims under the sleeve flange.

Upset the flange which attaches the sleeve to the frame. If a spare sleeve has been mounted, determine adjusting shim thickness T from the formula:

$$T = (A + B) - 1,020 \text{ mm (Fig. 78),}$$

where A - distance from frame bearing flange for the sleeve to the frame upper surface;

B - distance from the axis of the hole for the injector pipe union to the bearing surface of the sleeve flange. This size is equal to the difference in sizes punched on the sleeve end face;

(c) screw the studs (with a layer of whitening on the thread) into the sleeve jacket, and connect the water outlet branch pipe;

(d) mount the pipe unions of the injectors and starting valve. Fit the injectors and starting valve;

(e) pressure-test the diesel engine cooling system with water.

Start the independent water pump and make sure that no leakage is observed in the inner cavities of the exhaust manifold sections and along the face of the working cylinder sleeve.

172

50X1-HUM

50X1-HUM

55. To replace the exhaust manifold section, proceed as follows:
- (a) press out the working cylinder sleeve;
 - (b) remove the clips and disassemble the seals between the section being removed and the adjacent sections of the manifold;
 - (c) unlock and screw out the bolts that secure the manifold section to the frame; take out the manifold section;
 - (d) measure distance B (see Fig.79) on the removed and the newly installed manifold sections (from the section bearing surface to the step formed at the place where the section 280 mm inner diameter surface curves into a 284-mm diameter).
- Distance B measured on the newly installed section must be equal to, or smaller than distance B measured on the removed section;
- (e) mount the new section with the spacing ring (but without a rubber ring) into the frame, and check its alignment with the adjacent sections by the flats for the sealing rings.
- Misalignment of sections is allowed up to 0.2 mm. If the misalignment between the sections is above 0.2 mm, take the section with the spacing ring out of the frame and reduce the height of the spacing ring by a value necessary to ensure the permissible misalignment;
- (f) furnish the manifold section with new rubber rings, install it into the frame and assemble it in an order reverse to disassembly;
 - (g) in case size B on the newly installed section is larger than size B on the removed one, fit the working cylinder sleeve with the adjusting shims (but without rubber rings) into the frame, and measure distance A between the frame surface and the sleeve shoulder. (The shoulder is formed at the place where the 234 mm diameter surface curves into 250 mm diameter). Difference $A - (E+B)$ must be at least 1.5 mm, where E stands for the height of the spacing ring.

FUEL INJECTION EQUIPMENT

A. Injector

56. Having removed the injector (see Fig.28) from the diesel engine, proceed as follows:
- (a) remove carbon from the outer surface of the injector nozzle, and wash the threaded part of the pipe union with clean diesel fuel;
 - (b) check the injector for proper functioning on stand 47A -233-001. To this end:
 - attach the injector to the stand pipeline and inject fuel several times;
 - check the pressure of fuel injection start, as read by the pressure gauge; the fuel injection start pressure must be within 200 to 205 kgf/cm² with slow increase of fuel pressure. If necessary, the injector is allowed to operate with injection start pressure of at least 180 kgf/cm²; in this case, adjust the injection start pressure within 200 to 205 kgf/cm² by varying the thickness of the adjusting shims, as soon as possible. Never operate the injectors at injection start pressure lower than 180 kgf/cm²;
 - check for proper quality of fuel atomization, for which purpose wipe the nozzle dry, then perform 4 or 5 fuel injections by pressing abruptly the stand lever. The nozzle should remain dry. See

173
50X1-HUM

50X1-HUM

that the injection and shut-off of fuel are abrupt. Mist-like atomized fuel must flow out of all the nozzle orifices, and should have no separate drops or solid jets visible to the eye.

Clean the choked spraying orifices by means of cleaner 23-232-551, without disassembling the injector, then check the quality of fuel atomization again.

If the fuel flows in solid jets, or if drops are formed under the nozzle, disassemble the injector, wash the parts with filtered diesel fuel, after which assemble the injector again. In case washing fails to eliminate the fault, lap the needle valve sealing cone to the guide seat, according to the directions given in Para.58;

(c) if the results of check are satisfactory, mount the injector on the diesel engine, without disassembling it.

Note. When replacing the injector springs by new ones, readjust the injectors again after 20 - 40 hours of operation, so that they ensure normal fuel injection start pressure (200 to 205 kgf/cm²).

Bear in mind that a 0.1-mm change in the thickness of the shim placed under the spring changes the needle valve lift pressure by 10 kgf/cm².

57. The injector is to be disassembled in the following sequence:

(a) clamp the injector with its nozzle downwards in vice provided with soft (copper or aluminium) spacers on the jaws. Secure the injector by the thickened part of the body; do not use herein too high force, so as to avoid deformation of the body and wedging of the needle valve in the guide;

(b) unscrew nut 12 (Fig.28), remove sealing gasket 6 and adjusting shims 13, then take out the spring with the tappet;

(c) undo pressure nut 8 by means of wrench 61B - 232-210, then use puller 47B - 232-053 to press out the needle valve lift limiter complete with the textolite sealing ring;

(d) take out the guide with the needle valve, the nozzle and the steel sealing gasket by pressing against the nozzle with a copper drift.

58. During inspection of injector parts, do the following:

(a) wash all the injector parts with filtered diesel fuel; the precision parts are to be washed separately with filtered diesel fuel as well;

(b) check the needle valve for smooth travel along the guide, for which purpose move the needle valve out of the guide by 1/3 of its length, and incline the guide at 45° towards horizontal line. See if the needle valve moves smoothly in the guide under gravity at any turn about its axis. In case the needle valve moves tough, wash the parts of the couple again and repeat the check; should repeated washing of the couple parts with clean fuel fail to ensure free travel of the needle valve, replace the couple;

(c) if traces of cold hardening and insignificant notches are found on the surfaces of the sealing collar of needle valve cone and guide seat, worsening the sealing of these parts, eliminate the faults by lapping the needle valve cone and the guide seat to each other.

Carry out lapping by means of paste made of carborundum dust M10, GOST 3647-59, mixed with clean aircraft oil; apply the paste to the needle valve cone only. The bright lapped sealing collar must be located at the base of the needle valve cone. Try to ensure a minimum value of lapping, because the thinner the lapped collar, the more reliable the atomizer operation.

The lift of the needle valve in the guide, as measured by means of an indicator, must be within 0.5 to 0.55 mm. If the lift is above this value, lap the guide upper end face surface on a surface plate.

50X1-HUM

50X1-HUM

Parallel misalignment of the guide upper and lower end face surfaces is permissible up to 0.01 mm. To lap the surface, use polishing chromium paste, GOST 8217-56, diluted with kerosene;

(d) small nicks and notches found on the end face sealing surfaces of the nozzle and guide are to be removed by lapping on a surface plate with polishing chromium paste diluted with kerosene.

Note. Elimination of defects which require lapping of the sealing surfaces on a surface plate must be performed only in a specially equipped shop.

59. To assemble the injector, proceed as follows:

(a) measure the thickness of the shim at three points by means of a micrometer, then fit the shim and the nozzle into the injector body. Replace the shim if the difference in the micrometer readings exceeds 0.03 mm. When fitting the nozzle, follow the inscriptions (right-hand or left-hand) made on the injector body. The nozzle of the right-hand injector has a larger diameter spraying orifice (0.6 mm) on the side of the flat, while the nozzle of the left-hand injector has a smaller (0.45 mm) diameter spraying orifice on the same side (see Fig. 28);

(b) mount the guide with the needle valve, the needle valve lift limiter and the textolite sealing ring successively;

(c) screw-on pressure nut 8 and tighten it up by means of wrench 61Б -232-210 with a force applied by one hand. With the nut tightened up, a specific knock produced by the needle valve should be heard when the injector is being shaken slightly;

(d) fit the tappet, the spring with the set of adjusting shims, and the annealed copper sealing gasket, after which tighten up the nut reliably;

(e) check operation of the injector by means of stand 47Д -233-001.

60. When mounting the injector on the engine, take care to see that the injector with mark "right-hand" on its body is installed into the cylinder sleeve right-hand injector pipe union, whereas the injector with mark "left-hand" is fitted into the left-hand pipe union; pay also attention to ensure uniform tightening of the attachment bolts, so as to prevent deformation of the injector body.

Note. If the diesel engine cylinder is viewed from the side of the injectors, the right-hand injector pipe union will be on the right, and the left-hand one will be on the left.

Each time when installing the injector, place a new copper sealing gasket between the working cylinder pipe union and the injector.

B. High-Pressure Fuel Injection Pump

61. Disassembly and assembly of the fuel injection pump (see Fig. 27), with removal of the head, valve and plunger sleeve, are to be carried out only in a specially equipped shop. Partial disassembly with removal of the tappet, tappet spring, toothed bushing and plunger, is allowed on board the ship in cases of emergency; however, in this case it is forbidden to disturb the sealing of the screw which determines the position of the rack when it is being set with regard to the nominal fuel feed stop, and it is also forbidden to disturb the sealing of the screw which locks the plunger sleeve.

62. To disassemble the fuel injection pump, proceed as follows:

(a) clamp the fuel injection pump, with its tappet directed upwards, in a vice provided with soft spacers on the jaws (the pump is to be clamped by its housing flange). Press the tappet with your hand and use a screw driver to take the elastic ring that holds the roller pin in the housing guide slot out of the pump housing groove, after which take out the tappet;

175

50X1-HUM

50X1-HUM

(b) lift the plunger by the spring (through the housing slot) and take the retainer off the plunger tang.

Take out the spring, the plunger and the toothed bushing with the retainer, successively. Put the plunger on clean paper or cloth separately from the other parts;

(c) drive out the screw which limits the rack travel, then take the gear rack out;

(d) arrange the fuel injection pump with its head upwards, unlock and unscrew the nuts of the pump head fastening studs. Remove the pump head, the delivery valve lift limiter, the valve spring and the valve, in succession;

(e) press out the delivery valve seat together with the sealing ring by means of puller 47A-232-321. Never remove the valve seat by knocking it out through the plunger sleeve.

Drive the plunger sleeve locking screw out of the housing, and take out the sleeve. Put the delivery valve, valve seat and plunger sleeve on clean cloth or paper, separately from the other parts.

63. During inspection of the fuel injection pump parts, do the following:

(a) wash all the parts thoroughly with filtered diesel fuel;

(b) examine the sleeve and plunger working surfaces to make sure that they are of uniform brightness. The plunger moved out of the sleeve by 1/3 of its length must travel freely under gravity at any turn with regard to the sleeve, provided it is inclined at 45° towards horizontal line. The plunger couple should be replaced only in assembly;

(c) in case the delivery valve is loose, lap the valve to the seat.

Carry out lapping by means of paste made of carborundum dust M10, GOST 3647-59, mixed with aircraft oil; apply the paste to the valve cone only;

(d) if notches and spots of oxidized fuel are found on the end face surfaces of the plunger sleeve and delivery valve seat, remove them by lapping the above surfaces on a surface plate with the aid of polishing chromium paste diluted with kerosene;

(e) check whether the roller pin rotates freely in the tappet holes.

In case the pin is jammed and cold hardening is found on the surfaces of the pin and the tappet holes, eliminate the fault by lapping these surfaces by means of special laps with the aid of grinding paste in a specially equipped shop.

Take herein measure to protect the race of needle rollers on the pin.

The tappet needle rollers are to be replaced only in assembly.

When replacing the plunger couple, adjust the fuel injection pump for proper value of timed fuel feed and proper fuel injection start in compliance with respective specifications by means of an adjusting stand.

64. Adjustment of the fuel injection pump is carried out in the following sequence:

(a) clamp the pump housing, with its studs up, by the flange in a vice provided with soft spacers on the jaws.

Fit the plunger sleeve into the pump housing so that the sleeve slot is aligned with the pump housing hole for the locking screw, place a copper gasket under the locking screw, and tighten up the screw. With the locking screw tightened up, the plunger sleeve must be free to slightly travel axially in the housing.

When mounting the plunger couple, check contact between the bearing surfaces of the sleeve shoul-
der and the pump housing by paint pattern. If the above surfaces do not close-fit each other completely, lap them to each other with the aid of paste made of carborundum dust M10 mixed with aircraft oil;

50X1-HUM

50X1-HUM

(b) mount the delivery valve seat complete with the sealing ring, the valve, valve spring and valve lift limiter, into the pump housing.

Fit and secure the head on the housing studs so that the head pipe union is on the side of the pin available on the housing flange. Tighten up the nuts of the pump head fastening studs uniformly along a diagonal line with a force applied by one hand to a 300 mm long arm;

(c) check the lift of the delivery valve in the seat, and the travel of the plunger in the sleeve. The valve free travel and stroke are checked through the plunger sleeve and the valve seat hole by means of a clean smooth rod made of mild wire, 3 to 4 mm in diameter. The delivery valve must travel without jamming, and its stroke should be equal to 3.5 - 4 mm. If the delivery valve or plunger is jammed, release the pump head fastening nuts, then tighten them up uniformly again, so as to prevent deformation of the valve seat or the plunger sleeve;

(d) pressure-test pump cavity D with air at a pressure of 5 kgf/cm² in the course of 1 minute.

To this end, blank off the pump head pipe union, one of the unions of cavity D, and the holes for the rack and for its locking screw. Arrange the pump with its head down, insert the plunger into the sleeve, secure the plunger by the stop (to prevent it from being forced out by air), then prime clean diesel fuel into the space between the plunger sleeve and the housing. Supply air through the open union of cavity D.

In case air bubbles appear from the clearance between the plunger sleeve and the housing, lap the sleeve shoulder to the housing (see Para.64a);

(e) clamp the pump (with its head down) in a vice, mount the rack in the pump housing, and drive in the screw which limits the rack travel. Fit the toothed bushing on the plunger sleeve so that the bushing marked tooth is aligned with the circular notch made on the rack;

(f) mount the stationary retainer and the plunger spring in the pump housing, fit the retainer on the plunger tang and insert the plunger into the sleeve. The plunger marked guide must be aligned herein with the toothed bushing slot located on the side of the rack;

(g) fit the tappet into the pump housing and insert the locking ring into the housing groove in such a way that the ring lug gets into the housing slot in which the roller pin travels. When fitting the tappet, make sure that the plunger guides enter the toothed bushing slots. During axial travel of the plunger in the sleeve, the rack must move without any jamming.

65. To install the stand-by fuel injection pump, do the following:

(a) use a depth gauge to measure distance A (see Fig.80) from the frame flange surface on which the pump is to be installed to the cam plate pitch circle; determine the thickness of the set of shims to be placed under the new pump. This thickness is determined as the difference between distance H (the value of which is punched on the pump housing flange) and measured distance A, i.e.,

$$T_{\text{shim}} = H - A;$$

(b) place the shims of the required thickness under the pump flange and install the fuel injection pump on the diesel engine.

Tighten up the nuts of the pump securing studs uniformly along a diagonal line by means of wrench 61B -232-007;

(c) with the roller tappet being at pitch circle of cam plate, check position of plunger end face by means of gauge 47B -232-130 (see Fig.80) through the hole for the fuel pipeline unions.

50X1-HUM

50X1-HUM

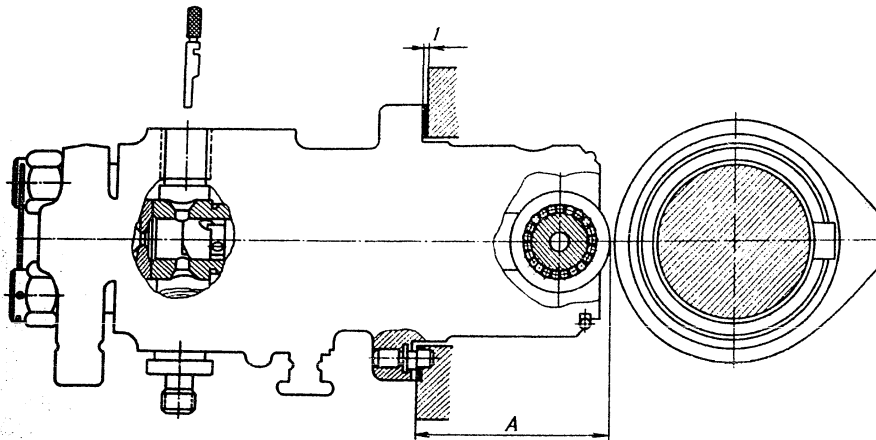


FIG. 80. INSTALLING THE FUEL INJECTION PUMP ON DIESEL ENGINE

l — thickness of shim

Note. Use gauge 4713-282-130 to check position of plunger and face, with the roller being at pitch circle of cam plate

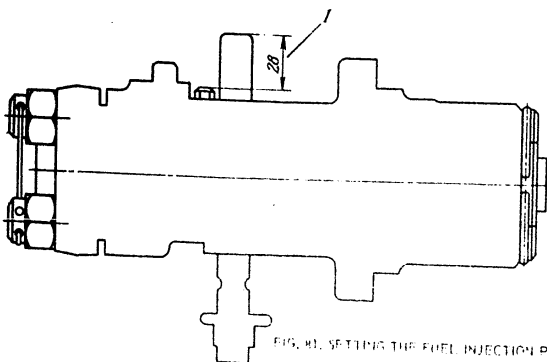
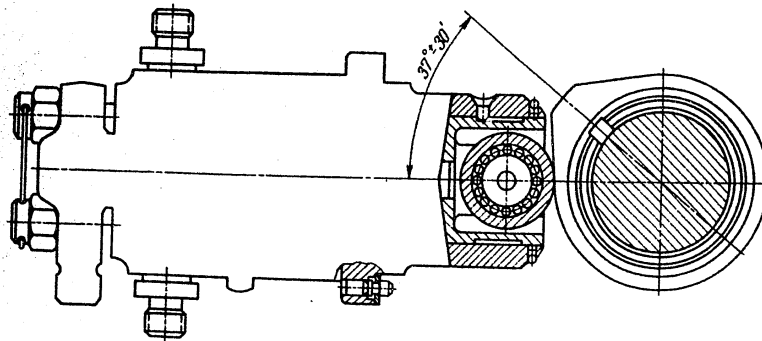


FIG. 81. SETTING THE FUEL INJECTION PUMP BACK WITH REGARD TO STOP

l — with regard to step 4713-242-012

178

50X1-HUM

50X1-HUM

The plunger should not overlap more than half the sleeve intake hole diameter so as to prevent the plunger end face from resting against the pump delivery valve seat.

(d) check (adjust) the fuel injection advance angle (see Sub-Section "Checking the Fuel System for Proper Sealing and Setting the Fuel Injection Advance Angles" of Chapter VI).

TURBO-SUPERCHARGER

66. Disassembly of the turbo-supercharger on the object is limited only to operations necessary for taking the turbo-supercharger out of the engine compartment and transporting it further.

The turbo-supercharger is to be disassembled and assembled in a specially equipped shop, and with the aid of tools and appliances delivered with the diesel engine.

67. When disassembling and assembling the turbo-supercharger, to maintain the dynamic balancing of the rotor and ensure proper quality of assembly, pay particular attention to the alignment of the match-marks and stamps on the following parts:

- (a) supercharger inducer and impeller;
- (b) supercharger impeller and rotor shaft key grooves;
- (c) keys and key grooves of rotor shaft;
- (d) bow part of fluid coupling driven rotor and turbo-supercharger rotor shaft (see Fig.13b);
- (e) fluid coupling driving rotor and turbo-supercharger drive gear shaft;
- (f) both driven rotor parts and fluid coupling drum;
- (g) fluid coupling bolts and locking plates;
- (h) thrust rings of supporting-and-thrust bearings.

68. To remove the turbo-supercharger from the diesel engine, proceed as follows:

- (a) disconnect and remove the branch pipes of the suction and exhaust pipelines. Detach the pipes which supply and return cooling water to/from the air coolers. Remove the air coolers with the bow and stern branch pipes. Disconnect the turbo-supercharger cooling and lubricating pipes;
- (b) open the handhole on the walls of the major accessories drive, near the fluid coupling. Turn the rotor and at the same time unlock and screw out successively the bolts that hold the bow part of the fluid coupling driven rotor to the drum;
- (c) detach the turbo-supercharger casing from the housing of the major accessories drive, sling and remove the turbo-supercharger.

Disassembling the Turbo-Supercharger

69. Disassembly of the turbo-supercharger is carried out in the following sequence:

- (a) arrange the removed turbo-supercharger in horizontal position;
- (b) unlock the washer and screw out the driven rotor fastening thrust bolt. Use a depth gauge to measure the distance from the stern end face of the fluid coupling driven rotor bow part to the end face of the turbo-supercharger shaft (i.e. negative allowance of the fluid coupling driven rotor on the turbo-supercharger shaft), and also the distance from the surface of the turbo-supercharger flange to the joint face between the bow driven rotor and the fluid coupling drum; this distance must be within $\begin{matrix} +4.8 \\ -1.85 \end{matrix}$;

(c) press the fluid coupling bow driven rotor off the turbo-supercharger shaft cone by means of puller 47A -232-087 and remove the bronze thrust ring;

179

50X1-HUM

50X1-HUM

(d) remove the supercharger casing inlet branch pipe, screw out the fairing by means of wrench 47A - 232-212, press off the supercharger inducer and impeller with the aid of puller 47A - 232-058, then detach and remove the volute;

(e) arrange the turbo-supercharger in vertical position so that the bow part is up, remove the bow bearing oil drain pipe, and remove labyrinth seal sleeve 3 (with the aid of two eye-bolts 47A - 232-208). To protect the rotor labyrinth seal collars, fit bushing 61B - 232-302 on the rotor shaft and remove the casing gas inlet part complete with the nozzle diaphragm assembly;

(f) take the rotor by means of eye-bolt 47A - 232-043 out of the turbo-supercharger casing gas outlet part and place it onto supports.

After disassembly is accomplished, remove resin and carbon from the turbo-supercharger cavities, wash all the parts with clean diesel fuel, blow them out with compressed air and wipe them until dry.

Inspection and Replacement of Parts

70. When inspecting the turbo-supercharger, check the following:

- (a) condition of supercharger impeller blades and inducer vanes (by fluorescent method);
- (b) condition of turbine impeller and guide vane assembly;
- (c) condition of edges of the turbine oil and gas seals, as well as condition of edges of the supercharger air seal sleeve;
- (d) condition of bearings.

71. Replace the turbo-supercharger rotor bearings in the following cases:

- (a) if the layer of lining is cracked or partially chipped;
- (b) if the layer of lining is fused, or galling is found on it.

72. If the end face of the thrust bronze ring of the bow bearing is worn, replace the ring, but take care to ensure axial play of the turbo-supercharger rotor (see table of clearances); the axial play is adjusted by grinding the stern end face of labyrinth seal sleeve 3, (Fig. 22b) or by undercutting its ground face.

In case the bronze thrust ring of the stern bearing gets worn by more than 1 mm in thickness, replace it by a spare one which has a thickness allowance. Turn this ring until its thickness obtains a value of

$$h = S - K - L \text{ (Fig. 82),}$$

where S - distance from the end face of the bearing to the end face of the thrust ring on the hub of the fluid coupling driven rotor loose-fitted (without negative allowance) on the turbo-supercharger rotor shaft cone. This distance is equal to

$$S = a + b - c,$$

where a - distance from the end face of the bearing to the end face of the turbo-supercharger rotor shaft when it is pressed towards the stern;

b - distance from the end face of the turbo-supercharger rotor shaft to the driven rotor bow part end face of the fluid coupling loose-fitted on the turbo-supercharger rotor shaft;

c - height of the fluid coupling bow driven part;

K - axial distance between the end face of the bearing and the end face of the bronze ring. This

50X1-HUM

50X1-HUM

distance is equal to 1.1 - 1.3 mm, provided the rotor is pressed off towards the stern and the fluid coupling is fitted with negative allowance L on the rotor shaft cone;

L - actual axial negative allowance of the fluid coupling on the shaft cone, which should be within 5.0 to 5.5 mm.

73. When mounting new bearings, check the following:

- (a) contact between the journals of the rotor shaft and the surface of the bearings; this contact must occupy at least 85 per cent of 120° arc of the bearing lower part;
- (b) clearances in the bearings and labyrinth seals of the rotor, in compliance with the table of mounting and operation clearances;
- (c) all axial clearances and plays specified in the turbo-supercharger Service Log.

Assembly and Installation of Turbo-Supercharger on Diesel Engine

74. Carry out assembly and installation of the turbo-supercharger on the diesel engine in the order reverse to disassembly.

Mount the parts in accordance with the match-marks made during disassembly.

When assembling, set the diffuser screw, the supercharger inlet branch pipe and the volute on special sealing compound "Hermetic V-50M" (see Appendix 16) at the joint faces.

Attach the turbine casing joint faces through heat-proof putty H3II (see Appendix 15).

Seal the flanged joints between the branch pipe, air cooler and receiver by means of gaskets made of oil-resistant medium-hard rubber of group A, GOST 7338-55.

Fit the fluid coupling driven rotor on the shaft taper end by knocking it slightly with a lead hammer (heat the fluid coupling rotor preliminarily up to a temperature not exceeding 150 - 180°C). When fitting the rotor, follow the value measured during disassembly (see Para.69), and see that the deviation is not above ± 0.15 mm. Before pressing the impeller and inducer on the rotor shaft, use an indicator to measure the rotor shaft axial play, which must be within the ranges specified in the table of mounting and operation clearances.

After the impeller and inducer are heated in an oil bath up to a temperature not exceeding 150 - 175°C, press them on the rotor shaft with the aid of appliance 47Д - 232-045 as far as labyrinth seal sleeve 3 (Fig.22b) permits. As the parts cool down, tighten up the appliance nut gradually so that no clearance is formed between the labyrinth seal sleeve end face and the impeller surface.

In a finally assembled turbo-supercharger its rotor must rotate without jamming.

75. When connecting the turbo-supercharger to the major accessories drive, check the following:

- (a) distance from the surface of the turbo-supercharger flange to the joint face between the bow driven rotor and the fluid coupling drum; this distance must be equal to the value measured during disassembly (see Para.69) with a deviation not exceeding ± 0.05 mm;
- (b) joint faces between the non-secured turbo-supercharger and drive. Up to 0.08 mm thick feeler gauge is allowed to pass through the joint;
- (c) turbo-supercharger rotor, fluid coupling and drive gear shaft heat expansion clearance measured between the bow end face of the drive stern bearing bushing and the end face of the gear; the clearance must be at least 3.0 mm.

Note. During replacement of the turbo-supercharger, in addition to the checks enumerated above, measure the misalignment and angularity of the drive gear shaft axis relative to the axis of

181

50X1-HUM

50X1-HUM

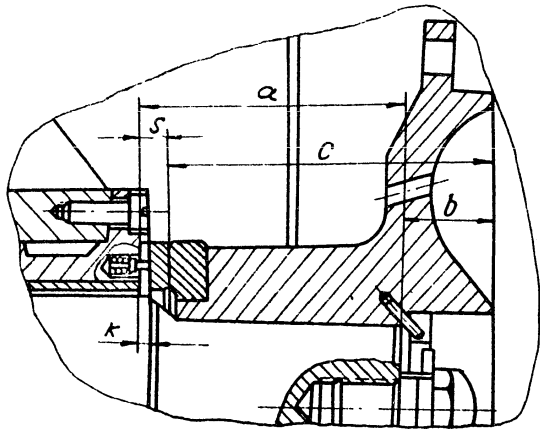


FIG. 82

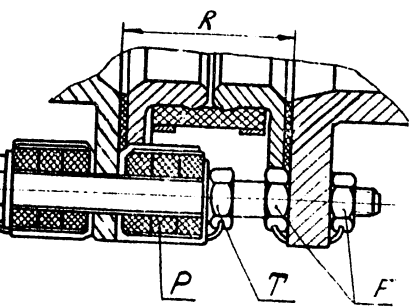


FIG. 83

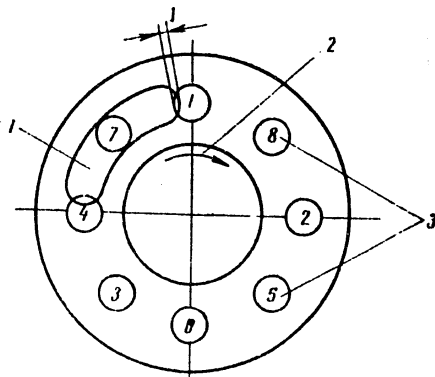


FIG. 84. SETTING THE AIR DISTRIBUTOR SLIDE VALVE ACCORDING TO THE FIRST CYLINDER DURING "AHEAD" ROTATION

1 - slide valve slot; 2 - direction of air distributor slide valve rotation; 3 - drum holes

50X1-HUM

50X1-HUM

the turbo-supercharger rotor shaft. The maximum permissible misalignment is 0,15 mm, while the angularity should not exceed 0,15 mm on the 250 mm diameter (fluid coupling flange).

Having mounted all the pipelines, check ease of rotation and axial play of the rotor shaft. To shift the rotor, fit the leg of appliance 472 - 232-096 into the fairing groove and make the appliance bar rest against the inlet branch pipe flange. Measure the value of the play by means of an indicator. In case jamming is observed, adjust the pressure of the bearing bracket stop cup and tighten up the fastenings of the gas supply and exhaust branch pipes anew.

Pay particular attention to the tightening-up of the shock absorbers at the supercharger volute branch pipes (see Fig.83).

During the assembly procedure make sure that nut T upsets rubber shock absorbers P by 1,5 to 2 mm.

Tighten up the branch pipe flange by means of nuts F so that size R remains constant (before and after the nuts are tightened up).

Forelock nuts F and T, and the bolt heads.

STARTING SYSTEM UNITS

A. Starting Air Distributor

76. To disassemble and inspect the air distributor (Fig.51), do the following:

- (a) detach the air pipes, unscrew the cover holding nuts and take the cover off the housing;
- (b) take the slide valve with the splined bushing and spring out of the housing;
- (c) remove the elastic rings from the pins, and take out the pins which interconnect the toothed racks of both air distributors and connect them to the rack bracket;
- (d) remove the housing, unlock and undo the drive gear fastening nut, and take the gear off the shaft;

(e) unlock and screw out the bolts that hold flange 8, remove the flange and take the shaft out of the housing;

(f) wash all the parts with filtered diesel fuel and wipe them dry;

(g) inspect the air distributor parts.

No scores are allowed on the friction surfaces of the shaft, drum end face, housing and slide valve; remove small notches from the above surfaces by polishing, and file-clean the notches found on the driving gear teeth and the splines;

(h) check contact between the slide valve and drum surfaces by paint pattern. When turning the slide valve through not more than 30° , the contact pattern should cover the entire working surface;

(i) before assembling the air distributor, coat the parts with a thin layer of oil used for lubricating the diesel engine.

To assemble the air distributor, proceed as follows:

- (a) fit the shaft into the housing, secure the flange, then upset and forelock the flange bolts;
- (b) check the shaft axial play (the set play is within 0,06 - 0,24 mm, the maximum permissible during operation is 0,40 mm);
- (c) secure the driving gear on the shaft;
- (d) mount and secure the air distributor assembled part on the flange of the minor accessories drive, then engage the gears.

183

50X1-HUM

50X1-HUM

- (e) set the racks of both air distributors in the AHEAD rotation position (shift them down as far as the stop permits), interconnect the racks in this position and connect them also to the rack stop;
- (f) arrange the lower piston of the 1st cylinder in its TDC;
- (g) fit the slide valve complete with the nut, splined bushing and spring on the shaft of the upper air distributor in such a way that the slide valve slot front edge (during AHEAD direction of rotation) overlaps the edge of the 1st cylinder hole in the drum by a value not exceeding 1 mm (see air distributor setting diagram, Fig.84).

Adjust the setting of the slide valve with regard to the drum by rearranging the splined joints of the slide valve, splined bushing and shaft. Similar setting of the lower air distributor is to be carried out relative to the 14th cylinder;

- (h) place annealed copper spacers under the covers, and secure the covers to the housings. Take herein care to see that the travel of the inner nut is within 1.0 to 3.0 mm;

- (i) attach the air pipes of the main starting valves and of the starting valves to the housing and covers.

Check operation of air distributors in compliance with sub-paragraphs "d" and "e" of Sub-Section "Checking the Diesel Engine Starting System" of Chapter VI.

B. Main Starting Valve

77. To disassemble, inspect, assemble and mount the main starting valve (Fig.49), do the following:

- (a) remove the upper and lower flanges, and take out the piston by means of eye-bolt 06296-00 provided with thread M8 x 1.25 (see Appendix 18);
- (b) disassemble the spring lock, take out the spring and valve 3, unscrew and disassemble shut-off valve C;
- (c) wash and inspect the valves. If necessary, remove notches and traces of jamming by file-cleaning, and lap the valves to their seats with the aid of POM paste (medium or fine);
- (d) wash all the parts with diesel fuel and coat them with a thin layer of oil used for lubricating the diesel engine;
- (e) prior to assembling the valve, check the following:
 - smoothness of piston travel in the sleeve under a load of 0.3 kg in vertical position of the body and at any turn of the piston;
 - smooth travel of valve 3 in the sleeve under gravity, in vertical position of the body and at any angle of turn of the valve.

Assemble the main starting valve in the order reverse to its disassembly and check proper sealing of valves 3 and C by pouring kerosene; no formation of kerosene drops at the seats is allowed in the course of 3 minutes;

- (f) mount the main starting valve on the diesel engine, and attach the air pipeline;
- (g) check sealing and functioning of the valve, as described in sub-paragraph "a" of Sub-Section "Checking the Diesel Engine Starting System" of Chapter VI.

184

50X1-HUM

50X1-HUM

C. Working Cylinder Starting Valve

78. To disassemble, inspect, assemble and mount the starting valve (Fig.50), do the following:

- (a) disconnect the air pipes, unscrew the valve fastening nuts and remove the valve;
- (b) unscrew the body nut, unlock and screw off the valve stem nut;
- (c) take the piston, spring and valve out of the housing;
- (d) clean the parts of carbon and dirt, wash them with clean diesel fuel, and then examine the parts.

The sealing surfaces of the valve and body must be free of notches, dints and other damage. Lap the valve to the seat, if needed, by means of POM paste (medium or fine);

(e) the valve lubricated with oil and arranged in vertical position must lower down in the housing by gravity, regardless of the valve turn;

(f) lubricate the parts with a thin layer of oil and assemble the valve in the order reverse to disassembly;

(g) after the valve is assembled, check proper lapping of the valve disc to the seat by pouring kerosene into cavity B; no kerosene is allowed to leak through the valve in the course of 3 minutes;

(h) replace the copper sealing gaskets in the unions, and mount the starting valves on the diesel engine. Tighten up the valve body fastening nuts uniformly in 2 or 3 motions;

(i) check sealing of the starting valves on the diesel engine, as described in sub-paragraph "b" of Sub-Section "Checking the Diesel Engine Starting System" of Chapter VI.

D. Emergency Control Station Starting Valve

79. To disassemble, inspect, assemble and mount the starting valve (Fig.47), do the following:

- (a) unscrew the plug and take out the spring, retainers and valves;
- (b) unscrew the locking bolt and take the knob out;
- (c) release the locking screw, turn out the nipple, undo the fastening of the relief valve and take the valve out of the nipple;

(d) wash all the parts with clean diesel fuel and check their condition;

(e) if necessary, lap the parts with POM paste (medium or fine);

(f) after the parts are lapped, wash them with clean diesel fuel and apply a thin layer of oil;

(g) assemble the starting valve in the order reverse to its disassembly, check the clearance between the end faces of the relief and control valves by measuring the knob stroke up to the opening of the control valve. The clearance should be within 2 ± 0.5 mm, and is to be adjusted by varying the thickness of the shim placed between the nipple and the valve body;

(h) mount the starting valve on the emergency control station, secure the valves and check them for proper sealing according to sub-paragraph "c" of Sub-Section "Checking the Diesel Engine Starting System" of Chapter VI.

50X1-HUM

50X1-HUM

OVERHAULING THE SEALS OF INJECTOR AND STARTING VALVE PIPE UNIONS, AND SEALS OF FUEL FEED AND WATER PUMPS

A. Overhauling the Seals of Injector Pipe Unions

80. To seal the injector pipe unions (Fig.17) in case water leaks onto the face of the working cylinder sleeve, do the following:

- (a) drain water out of the cooling system;
 - (b) disconnect the high-pressure pipe and the pipe for fuel leaking from the injector;
 - (c) remove the injector and take the rose-copper gasket out of the pipe union seat;
 - (d) screw out the body of pipe union 20 by means of appliance 47B - 232-088, and remove the pressure blocks and the rubber gasket;
 - (e) use appliances 47B - 232-097 and 61B - 232-003 to screw pipe union 23 out of the cylinder sleeve.
- Remove the rose-copper gasket, then clean and examine the parts;
- (f) place a new annealed rose-copper gasket under the pipe union, screw the latter into the cylinder sleeve and tighten it up with a force applied by one hand to the arm of the lever of appliances 47B - 232-097 and 61B - 232-003.
- Then remove the lever and screw in the pipe union additionally through an angle of 45 to 90° ;
- (g) check condition of pressure blocks and rubber gasket. Replace the gasket if it has lost its elasticity or shape;
 - (h) fit the blocks and the rubber gasket into place, screw on the pipe union body and tighten up the rubber gasket through 1.5 to 2 revolutions. Take herein care to see that a clearance of 0.5 to 2.5 mm is left between the end face of the pipe union body flange and the generatrix of the cylinder sleeve jacket;
 - (i) check proper mounting of the pipe union with the aid of appliance 47B - 232-094. The appliance must close-fit the cylinder jacket surface and at the same time it should be pressed to the surface of the injector fastening bolts screwed into the pipe union. A clearance not exceeding 0.5 mm is permissible between one of the bolts and the appliance control surface;
 - (j) fill the cooling system with water and pressure-test it at a pressure of 3 kgf/cm^2 ;
 - (k) fit the injector on a new annealed rose-copper gasket and tighten up the injector holding bolts uniformly. Check the clearance between the milled part of the pipe union and the side stem of the injector body; the clearance should be at least 0.5 mm;
 - (l) to seal the injector pipe union in case of outside water leakage, do not perform the operations specified in sub-paragraphs "e" and "f".

B. Overhauling the Seals of Starting Valve Pipe Unions

81. To seal the starting valve pipe union (Fig.17) in case water leaks onto the cylinder sleeve face, do the following:

- (a) drain water out of the cooling system;
- (b) disconnect the air pipes from the valve. Release the starting valve securing nuts and remove the valve. Take the rose-copper gasket out of the pipe union seat;
- (c) unscrew the pipe union nut with the aid of wrench 61B - 232-002 and remove the pressure rings,

50X1-HUM

50X1-HUM

OVERHAULING THE SEALS OF INJECTOR AND STARTING VALVE PIPE UNIONS, AND SEALS OF FUEL FEED AND WATER PUMPS

A. Overhauling the Seals of Injector Pipe Unions

80. To seal the injector pipe unions (Fig. 17) in case water leaks onto the face of the working cylinder sleeve, do the following:

- (a) drain water out of the cooling system;
 - (b) disconnect the high-pressure pipe and the pipe for fuel leaking from the injector;
 - (c) remove the injector and take the rose-copper gasket out of the pipe union seat;
 - (d) screw out the body of pipe union 20 by means of appliance 47B - 232-088, and remove the pressure blocks and the rubber gasket;
 - (e) use appliances 47B - 232-097 and 61B - 232-003 to screw pipe union 23 out of the cylinder sleeve.
- Remove the rose-copper gasket, then clean and examine the parts;
- (f) place a new annealed rose-copper gasket under the pipe union, screw the latter into the cylinder sleeve and tighten it up with a force applied by one hand to the arm of the lever of appliances 47B - 232-097 and 61B - 232-003.
- Then remove the lever and screw in the pipe union additionally through an angle of 45 to 90°;
- (g) check condition of pressure blocks and rubber gasket. Replace the gasket if it has lost its elasticity or shape;
 - (h) fit the blocks and the rubber gasket into place, screw on the pipe union body and tighten up the rubber gasket through 1.5 to 2 revolutions. Take herein care to see that a clearance of 0.5 to 2.5 mm is left between the end face of the pipe union body flange and the generatrix of the cylinder sleeve jacket;
 - (i) check proper mounting of the pipe union with the aid of appliance 47A - 232-094. The appliance must close-fit the cylinder jacket surface and at the same time it should be pressed to the surface of the injector fastening bolts screwed into the pipe union. A clearance not exceeding 0.5 mm is permissible between one of the bolts and the appliance control surface;
 - (j) fill the cooling system with water and pressure-test it at a pressure of 3 kgf/cm²;
 - (k) fit the injector on a new annealed rose-copper gasket and tighten up the injector holding bolts uniformly. Check the clearance between the milled part of the pipe union and the side stem of the injector body; the clearance should be at least 0.5 mm;
 - (l) to seal the injector pipe union in case of outside water leakage, do not perform the operations specified in sub-paragraphs "e" and "f".

B. Overhauling the Seals of Starting Valve Pipe Unions

81. To seal the starting valve pipe union (Fig. 17) in case water leaks onto the cylinder sleeve face, do the following:

- (a) drain water out of the cooling system;
- (b) disconnect the air pipes from the valve. Release the starting valve securing nuts and remove the valve. Take the rose-copper gasket out of the pipe union seat.
- (c) unscrew the pipe union nut with the aid of wrench 61B - 232-002 and remove the pressure rings.

188

50X1-HUM

50X1-HUM

(d) use appliance 61B - 232-014 to screw the starting valve pipe unions out of the cylinder sleeve, then take-off the rose-copper gasket;

(e) clean and inspect the parts. Select a new annealed rose-copper gasket so that it is 0.3 to 0.5 mm thicker than the removed one. In case the rubber gasket is torn, replace it by a new one and attach it by means of glue H-88 to the cleaned surface of pressure ring 17;

(f) screw the starting valve pipe union into the working cylinder sleeve and tighten it up with a force applied by one hand to the arm of the lever of appliance 61B - 232-014. The pipe union should not approach its constant position by 45 to 90° (as to the angle of turn). Then lengthen the lever and tighten up the pipe union additionally until it occupies a position in which the indicator valve is located strictly vertical on top;

(g) mount the pressure ring with the rubber gasket glued to it, fit the rubber ring and the pressure ring, after which screw the sealing nut on the pipe union;

(h) fill the cooling system with water, bleed the air out, and pressure-test the system at a pressure of 3 kgf/cm²;

(i) fit the starting valve on a new annealed gasket and tighten up the valve fastening nuts uniformly;

(j) to seal the starting valve pipe union in case of outside leakage of water, do not fulfil the operations specified by sub-paragraphs "d" and "f".

C. Overhauling the Fuel Feed Pump Seal (See Fig. 26)

82. The fuel feed pump seal is to be overhauled in case more than 15 drops of fuel leak through cover hole 32 (See Fig. 11b) per minute.

83. To overhaul the seal, proceed as follows:

(a) remove the fuel feed pump from diesel engine;

(b) take out the textolite retainer of the drive coupling;

(c) press the half-coupling off the pump shaft, and remove the pressure cover;

(d) take the step bearing out of cover 16 (Fig. 26), and remove the graphite and rubber rings from the pump shaft;

(e) wash and inspect the parts of the seal; during inspection pay particular attention to the condition of the surfaces of the graphite ring slots and the pressure ring grooves; file-clean the nicks, if any;

(f) lap the step bearing working surface to a surface plate with a thin layer of TOI paste until the contact covers at least 85 per cent of the surface; then lap it to a wet cast-iron surface plate without any abrasive, to obtain mirror finish of the surface and a contact of at least 85 per cent;

(g) assemble the pump seal and take care to see that the pressure ring lugs enter the graphite ring slots. Check ease of graphite ring axial travel when loaded by spring;

(h) place a new gasket under the pressure cover, insert the step bearing into the pump cover, and fit the pressure cover into place. Check the pump shaft for easy rotation;

(i) press the half-coupling onto the pump shaft, fit the drive textolite retainer into place, and install the pump on the diesel engine;

(j) assemble the fuel pipeline, prime the system and pressure-test it for a pressure of 3 kgf/cm².

187

50X1-HUM

50X1-HUM

D. Overhauling the Seals of Fresh and Sea Water Pumps (See Fig. 37)

84. Overhaul the seals in case more than 15 drops of water leak from the fresh water pump per minute, or if more than 30 drops leak from the sea water pump.

85. The seal is to be overhauled in the following sequence:

- (a) drain water out of the respective system (fresh or sea water);
- (b) disconnect the pump suction and delivery pipelines and blank them off by means of plugs;
- (c) mark the mating surfaces of the pump housing, volute and branch pipe;
- (d) remove the pump suction branch pipe;
- (e) unlock the plate washer, then release and remove the nut (fairing);
- (f) press off the impeller with the aid of puller 47A - 232-084;
- (g) take the sealing ring off the pump shaft;
- (h) use puller 47A - 232-085 to press out the oil seal bushing with the graphite ring glued into it;
- (i) clean the joints of the housing parts, remove the remaining sealing compound from the joint faces, and make sure that the centring grooves are free of nicks and galling;
- (j) check flatness of the end face and the centring groove of the cup thoroughly;
- (k) clean and inspect the other parts.

86. No nicks and notches are allowed on the working surface of steel sealing ring 9.

Prior to fitting the sealing ring on the shaft, lap the ring working surface on a surface plate with a thin layer of paste FOH.

The ring should contact the plate by at least 85 per cent of the surface.

Then lap the ring to a wet cast-iron surface plate without any abrasive, until mirror finish of the surfaces is obtained.

87. In case deep notches are found on the working surface of the bushing graphite ring, undercut the surface on a lathe, but do your best to ensure the least possible undersizing of the surface.

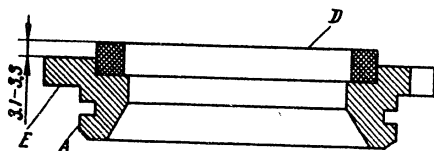


FIG. 85. BUSHING WITH GRAPHITE RING

If the graphite is chipped and cracked, or if the graphite ring projects from the bushing by less than 1 mm, replace the ring. It is allowed to glue a new graphite ring by means of epoxy resin, and then to finish the working surface (see Fig. 85).

After the working surface is finished, check the following:

- (a) out-of-flatness of surfaces D and E, which should not exceed 0.03 mm;
- (b) run-out of surfaces D and E relative to the axis of surface A; run-out is allowed up to 0.02 mm on dia. 50 mm.

Before fitting the seal bushing into the pump cup, lap the graphite ring working surface to a wet cast-iron surface plate without abrasive, until a mirror finish of the surface and a contact of at least 85 per cent are obtained.

Replace the rubber sealing ring by a new one in case it is cut, or if it has lost its elasticity or shape.

88. To assemble the pump, proceed as follows:

- (a) fit the rubber ring on the seal bushing, but take measures to prevent twisting of the ring;

50X1-HUM

50X1-HUM

- (b) lubricate the rubber ring with oil and press the bushing into the pump cup;
- (c) fit the steel and rubber sealing rings, as well as the spacer ring and the spring, on the shaft, and make sure that the rings are free to travel when actuated by the spring;
- (d) mount the volute into place, and press the pump impeller on;
- (e) attach the suction branch pipe to its seat.

Note. Attach the joints of the branch pipe, volute and cup of the pump on sealing compound "Hermetic"

89. Having assembled the pump, blank off the suction and delivery branch pipes, bleed the air out, pressure-test the pump with water for a pressure of 3 kgf/cm^2 and at the same time turn the diesel engine. No leakage is allowed.

Insignificant dripping (3 to 5 drops per minute) is permissible. After the water pipeline is assembled, pressure-test the system with water at a pressure of 2 kgf/cm^2 , and make sure that it is not leaky.

FUEL AND OIL FILTERS

A. Fuel Filter (See Fig.25)

Washing One of the Sections by Counterflow of Clean Fuel from the Other Section

90. Carry out washing with the independent fuel feed pump engaged, or if necessary during engine operation at idle speed or minimum load.

Washing is performed in the following sequence:

- (a) turn cock 8 so that the indicator available on its end face occupies position \diamond , if the right-hand section is to be washed, or position \diamond , if the left-hand section of the filter is to be washed;
- (b) open drain plug 11 of the section to be washed, and drain the fuel out in a strong jet, until clean fuel starts flowing;
- (c) after both sections are washed, close drain plug 11 and turn cock 8 to its working position \diamond

Replacing the Filtering Element

91. Replace the filtering element as follows:

- (a) screw out bolt 10, remove casing 15, spring 9 and the filtering element;
- (b) clean the casing and all the removed parts with clean diesel fuel;
- (c) mount a new filtering element, the spring and the casing, and tighten up bolt 10.

Note. When assembling, pay attention to see that felt seals 13 and 17, and also the paronite gaskets are intact. Replace the damaged seals and gaskets.

B. Oil Filter (See Fig.32)

92. To disassemble and clean the oil filter cartridges, do the following:

- (a) pump oil out of the sections by means of the independent oil pump;
- (b) release the nuts of the fastening studs, and detach the covers of the casing sections;
- (c) take out the cartridge of filtering elements, and wash the outer surface of the elements with clean diesel fuel;

50X1-HUM

50X1-HUM

open indicator valve, or from the scavenging and exhaust ports of the cylinder sleeve. During engine operation, looseness of the starting valve causes heating of the pipe which feeds starting air to the valve.

Remove the defective starting valves, disassemble them, lap and then check for sealing again;

(c) check sealing of the emergency control station starting valve in the following sequence:

- set the control selector switch in position CONTROL PANEL;
- supply air at a pressure of 30 kgf/cm^2 to the starting valve;
- do not push the valve button, and make sure that no air leaks through the body relieving hole;
- shut-off the air supply from the starting cylinders and check ease of valve opening by pushing the button as far as it will go and then releasing it; the valve must quickly return to its initial position;

(d) check proper connection of pipes running from the cylinder starting valves to the air distributors, for which purpose compare the cylinder numbers punched against the respective holes on the air distributor housings;

(e) remove the air distributor covers and do the following:

- check setting of air distributor slide valves, i.e. see if the air feed corresponds to the cylinder firing order; bear herein in mind that the direction of rotation of the slide valves coincides with the direction of rotation of the upper crankshafts;
- make sure that the supply of air into any cylinder begins when the lower piston of this particular cylinder is in a position of 0 to 3° before TDC (during AHEAD direction of rotation);

(f) pressure-test the starting system pipelines with air at a pressure of 30 kgf/cm^2 .

Eliminate leakage found during pressure-testing.

To check reliability of the starting system, it is advisable to turn the diesel engine with starting air from the emergency control station and the remote control panel.

B. Checking Proper Linkage of Control Rods and Levers with the Emergency Control Station, Governor, Fuel Injection Pumps and Overspeed Governor

To carry out the above checks, proceed as follows:

(a) check the control rods and levers for free travel;

(b) set the governor control handle in vertical position and shift the emergency control station handle in the direction of supply until the governor load indicator occupies a position corresponding to 50 per cent.

In this position:

- the emergency control station handle must be within divisions 4.5 - 5.0;
- the angles between the fuel injection pump side rods and the lateral shaft levers, between the lateral shaft lever and the emergency control station rod, between the lateral shaft lever and the governor spring-loaded rod, as well as between the spring-loaded rod and the governor lever, must be equal to $90 \pm 5^\circ$

At the same time, the governor lever and the speed control servo-motor rod, as well as the servo-motor rod and the governor remote control mechanism lever, must be at a square angle towards each other. If the above requirements are not satisfied, carry out readjustment by changing the length of the rods running to the emergency control station and servo motor, or the length of the spring-loaded rod between the lateral shaft and the governor.

50X1-HUM

50X1-HUM

(c) set the handles of the speed governor and the emergency control station to the maximum feed, and turn the knob of the emergency control station fine adjustment shaft until the overhang of the stern fuel injection pump rack of the 8th cylinder is 28 ± 0.1 mm (as measured with the aid of appliance 61B-232-045).

In this position:

- the emergency control station handle must be on division 9 - 10;
- the governor load indicator must point to division 98 - 105;
- the overhang of the racks in the other fuel injection pumps (as measured with the aid of appliance 61B-232-045) must correspond to the values indicated in the diesel engine Service Log (and should be accurate within ± 0.2 mm).

If the deviation of the rack position exceeds the above ranges, adjust the linkage between the rack and the control rod. To this end, release the locking screw of the clip on the rack roller, rotate the roller and set the rack in the required position.

To check the rack overhang by means of appliance 61B-232-045 (see Fig. 85a), proceed as follows:

Release cup 4, fit appliance body 1 on the fuel injection pump rack and clamp the body to the rack end face. Take care to see that spring 3 presses herein the end face of cup 4 to the spherical head of the bolt on the pump housing.

Then secure the cup in position by means of screw 5, after which take the appliance off the rack and measure size B accurate within 0.1 mm.

Rack overhang D will be equal to the difference between sizes B and K ($D = B - K$), where K - constant size punched on the appliance body.

It is not advisable to measure size D directly by means of a depth gauge, as it may result in considerable errors.

Ensure a clearance of 1.0 to 1.5 mm on the

outer side between the shank axle and the rod in the rod eye of the overspeed governor actuating mechanism.

The clearance between fuel feed limiter rod 1 (Fig. 48b) and the lateral shaft lever stop must be within 0.4 to 0.6 mm. Adjustment of clearance between the rod and the lever stop is carried out by turning the adjusting screw, and then securing it with the locknut, and sealing;

(d) shift the governor speed-control handle and the emergency control station handle to position STOP.

In this case, the fuel injection pump racks must be moved out by a value not exceeding the size of the zero feed stop;

(e) when overhauling and adjusting the fuel injection pump control mechanism, fit the levers on the splined shafts of the speed governor and the governor remote control mechanism only in accordance with the match-marks.

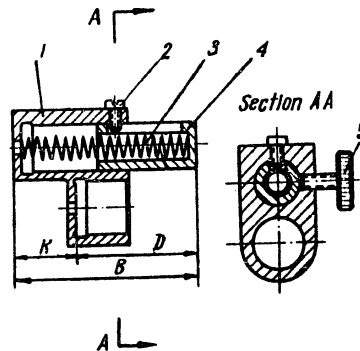


FIG. 85a. CHECKING THE RACK OVERHANG BY MEANS OF APPLIANCE 61B-232-045

1 - body; 2 - screw; 3 - spring; 4 - cup; 5 - screw

50X1-HUM

50X1-HUM

It is not recommended to change the length of the spring loaded rod which links up the governor servo-motor shaft lever with the lateral shaft lever.

C. Checking the Fuel System for Proper Sealing and Setting the Fuel Injection Advance Angles

To check the fuel system for proper sealing, proceed as follows:

- (a) prime the system with diesel fuel by means of the independent fuel feed pump, and eliminate leakage, if any;
- (b) prime the system with fuel until fuel without air bubbles starts flowing out of the pipe union on the uppermost point of the system;
- (c) close the pipe union and pressure-test the system with fuel at a pressure of 3 kgf/cm^2 for 10 minutes; no leakage is allowed;

Note. Due to the fact that some portion of fuel-and-oil mixture necessary to ensure easy travel of the high-pressure fuel injection pump racks gets onto the racks during diesel engine operation, insignificant leakage (not more than 3 drops in the course of 5 minutes) is allowed along the racks at rated speed of diesel engine.

- (d) adjust the pressure in the system within 1.0 to 1.2 kgf/cm^2 .

Carry out adjustment of the fuel injection advance angles with regard to the stern fuel injection pumps of the 8th and 16th cylinders in the following sequence:

- (a) detach the high-pressure pipe from the pump, and move appliance 47B-232-055;
- (b) set the 8th cylinder stern fuel injection pump rack overhang within $\pm 0.05 \text{ mm}$ by means of appliance 61B-232-045.

When adjusting the fuel injection advance angles, see that the pressure of fuel in the supply pipeline is 1 kgf/cm^2 ;

- (c) turn the crankshafts through 1 or 2 revolutions by means of the shaft barring arrangement and see if the transparent pipes of appliance 47B-232-055 get filled with fuel;
- (d) drain part of fuel out of the appliance glass pipe and make sure that the fuel injection pump delivery valve is sealed properly (the level of fuel in the appliance pipe should not increase);
- (e) turn the diesel engine crankshafts clockwise with the aid of the shaft barring arrangement (by intermittent short-time engagements of the electric motor), notice the moment when the fuel level (meniscus) in the appliance pipe starts rising; and at the same time cut out the electric motor. In this position determine the fuel injection advance angle by the graduation available on the coupling of the respective lower crankshaft.

The fuel injection advance angles for all the cylinders must correspond to the values specified in the Service Log, and should be within 14 to 22° . When checking the fuel injection advance angles, follow the diesel engine cylinder firing order, which is 1-14-8-11-2-12-5-15-6-9-3-16-4-10-7-13.

If it is necessary to change the fuel injection advance angle for a separate fuel injection pump, vary the thickness of the set of adjusting shims placed under the pump flange.

During adjustment, the thickness of the set of adjusting shims may be changed within $\pm 0.5 \text{ mm}$ relative to the rated value (see Para. 65a of Section "Fuel Injection Equipment").

A 0.25 mm reduction in the thickness of the set of shims placed under the pump flange increases the fuel injection advance angle by 1° . Having reduced the thickness of the set of shims, use gauge 47B-232-130 to check the position of the plunger end face relative to the plunger sleeve holes.

50X1-HUM

50X1-HUM

F. Checking the Speed Governor Remote Control System for Proper Functioning

To check functioning and to carry out adjustment of the panel setter and governor speed-control servo-motor, use compressed air at a pressure of $4 \pm 0.2 \text{ kgf/cm}^2$, and proceed as follows:

Disengage the governor speed-control handle from the sector, for which purpose push the handle button and turn the handle clockwise through 90° .

Check sealing of the control system air pipeline joints.

With the panel control handle set to position STOP, the setter air outlet pressure (as read by the pressure gauge connected to setter cavity B) must be within $1.3 \pm 0.1 \text{ kgf/cm}^2$, while the speed-control handle on the governor must be between the first two notches in the left-hand part of the STOP zone scale.

To adjust the setter for the above value of air pressure, turn the tappet. If the setter air outlet pressure is insufficient, turn the tappet counter-clockwise, whereas when the pressure is too high, turn the tappet clockwise.

Shift the panel control handle to division 9 of the scale. In this case, the setter air outlet pressure must be within $3.2 - 3.6 \text{ kgf/cm}^2$, and the governor speed-control handle must be within the zone of divisions 15 - 17. If the governor handle is in some other position, adjust speed-control servo-motor spring 12 (Fig. 46), proceeding from the following: if the handle fails to approach the required position, reduce the servo-motor spring tension by turning adjusting nut 7 counter-clockwise; if the handle overruns the required position, increase the spring tension, for which purpose turn the adjusting nut clockwise.

Having adjusted the setter of the panel and the speed-control servo-motor, check the remote control system for proper functioning again, as described above.

After this is done, check position of the governor handle, with the panel handle being set for fuel shut-off. When the panel handle is set to division 3 - 3.5, the governor handle should be between divisions 4.5 - 6.0.

RUNNING-IN AND ADJUSTING THE DIESEL ENGINE DURING OPERATION

1. Running-in of diesel engine after overhauls, repairs and preliminary adjustment is to be performed at propeller performance. The turn of the propeller blades in units with a variable-pitch propeller must correspond to the flank speed position.

The first starting of the diesel engine should be done only from the emergency station, while control of engine may be exercised from the remote control panel.

2. Before running-in the engine, do the following:

- (a) clean and wash all the oil filter cartridges;
- (b) force oil completely out of the engine and system into the service tank;
- (c) carry out heating and separation of oil in the tank;
- (d) after the oil is separated, send it for analysis, to make sure that it corresponds to the requirements laid down in Specifications MPTV 12H No. 24-63.

3. The duration of running-in and adjustment of diesel engine during operation is as follows:

- (a) 6 hours (according to Table 1) - in case the engine has been overhauled without replacement of parts, and also if any parts of the turbo-supercharger (except those indicated in sub-paragraph "b") have been replaced;

50X1-HUM

50X1-HUM

(b) 15 hours (according to Table 2) - after the replacement of one or several pistons and cylinder sleeves (separately), end main or crankpin bearings, bushes, and thrust rings of turbo-supercharger rotor;

(c) 21 hours (according to Table 3) - after one or several mating sets of the cylinder sleeve and piston have been replaced.

4. Change over the engine from one rating to the other, and stop it after the ratings are accomplished, smoothly in the course of 3 to 5 minutes.

5. During the running-in procedure, carry out periodic inspections of diesel engine, as follows:

(a) check heating of main and crankpin bearings to the touch;

(b) inspect the inner fastenings;

(c) check condition of working cylinder sleeves, pistons and compression rings through the scavenging and exhaust ports;

(d) examine the screens of the scavenging pipeline oil filter. Appearance of growing amounts of small bronze particles on the filter screens is indicative of abnormal wearing of end bearings, main drive thrust bearing, or turbo-supercharger thrust bearing. In this case, inspect the diesel engine thoroughly, find the abnormally functioning units, disassemble them and eliminate the faults. If insignificant amounts of bronze or babbitt particles are found on the filter walls, and also if bright spots are detected on the piston trunks and cylinder sleeves, continue the running-in procedure, but increase the duration of low-load operation; the number of inspections of these cylinders should be increased;

(e) inspect the inner cavities of the exhaust manifold traps.

6. When adjusting the diesel engine during the running-in procedure, follow the results of diesel engine bench tests carried out at the Manufacturing Plant, and also the values of parameters obtained before from the engine adjusted at the same speeds and loads.

7. During adjustment of the diesel engine, do the following:

(a) carry out preliminary adjustment of engine during maximum mooring trial rating in such a way that the mean value of maximum combustion pressure P_z in one row of cylinders does not differ from the mean value of pressure P_z in the other row of cylinders by more than 6 kgf/cm^2 , and that the average temperature of exhaust in the cylinders of one row does not differ from the temperature of exhaust in the cylinders of the other row by more than 60°C ;

(b) during sea trials, carry out full-scale measurements at all ratings with a duration above 1 hour.

Measure the combustion pressure at ratings of 650, 770 and 850 r.p.m.;

(c) at a 75 per cent power rating during operation at propeller performance, check the combustion pressure in all cylinders, for which purpose shut-off the cylinders alternately by setting the fuel injection pump racks to the ZERO feed with the aid of stop 47Д-232-012.

Prior to connecting the maximum pressure gauge, open and scavenge the indicator valve.

The combustion pressure should be at least 50 kgf/cm^2 ; take care to see that the difference in the values of combustion pressure between separate cylinders is not in excess of 10 kgf/cm^2 . If the combustion pressure in some cylinder is beyond the above range, or if the difference between the pressure values in the cylinders is above 10 kgf/cm^2 , adjust the combustion pressure in the cylinders by selecting the necessary compression plates of the connecting rod. A 0.5-mm change in the thickness of the plate changes the combustion pressure by about 2 kgf/cm^2 .

197

50X1-HUM

50X1-HUM

CAUTION! When replacing the injectors and pump rack spacers, remove the spacers of this particular cylinder to the maximum permissible height of the compression chamber is heretofore specified.

(d) after final adjustment of the fuel injection pump racks, the parameters should not exceed the values obtained during previous tests and specified in the diesel engine Service Log.

CAUTION! Never equate the concentration of exhaust gases in the cylinders by changing the position of the fuel injection pump racks with the aim of changing the fuel feed ensured by the pumps.

(e) during the flank speed trials, observe the following:

- write down the position of the governor lead indicator pointer into the test certificate; the pointer should be in a position indicated in the engine Service Log;
- check the strokes of the fuel injection pump racks for the 4th, 8th, 9th and 16th cylinders, and enter the values into the test certificate; the strokes should not exceed the values indicated in the engine Service Log;

8. When running-in the diesel engine at sea trial ratings, measure the parameters at steady rating, under the condition that the ship's course is straight and the sea is moderate.

Table 1

Operation rating	Crankshaft speed, r.p.m. (for installations with a variable-pitch propeller)	Duration of operation (hr, min)		Inspections
		at rating	total	
1	2	3	4	5

Operation at mooring trials

Ahead running, with zero turn of the variable-pitch propeller	300	0 - 15	0 - 15	See Para.5 (a,b)
Ahead running, with the out-board pitch indicator being in a position corresponding to flank speed	350	0 - 15	0 - 30	
Same	480	0 - 20	0 - 50	
Same	510	0 - 30	1 - 20	
Same	560	0 - 40	2 - 00	

Operation at sea trials

Ahead running, with zero turn of the variable-pitch propeller	300	0 - 10	2 - 10	
Ahead running, with the out-board pitch indicator being in a position corresponding to flank speed	350	0 - 10	2 - 20	
Same	420	0 - 20	2 - 40	
Same	480	0 - 30	2 - 50	

100

50X1-HUM

50X1-HUM

1	2	3	4	5
Ahead running, with the outboard pitch indicator being in a position corresponding to flank speed	560	0 - 10	3 - 00	See Para.5 (a,c,d)
Same	650	0 - 30	3 - 30	
Same	730	0 - 20	3 - 50	
Same	770	0 - 30	4 - 20	
Same	820	0 - 30	4 - 50	
Same	850	0 - 30	5 - 20	
Same	650	0 - 40	6 - 00	See Para.5 (a,b,c,d,e)

Table 2

Operation rating	Crankshaft speed, r.p.m. (for installations with a variable-pitch propeller)	Duration of operation (hr, min)		Inspections
		at rating	total	
1	2	3	4	5

Operation at mooring trials

Ahead running, with zero turn of the variable-pitch propeller	300	0 - 10	0 - 10	See Para.5 (a,b)
Ahead running, with the outboard pitch indicator being in a position corresponding to flank speed	350	0 - 15	0 - 25	
Same	380	0 - 20	0 - 45	See Para.5 (a,b,c,d)
Same	420	0 - 20	1 - 05	
Same	450	0 - 20	1 - 25	
Same	480	0 - 20	1 - 45	
Same	510	0 - 30	2 - 15	
Same	560	0 - 45	3 - 00	
Astern running, with the outboard pitch indicator being in a position corresponding to flank speed	350	0 - 10	3 - 10	

Operation at sea trials

Ahead running, with zero turn of the variable-pitch propeller	300	0 - 10	3 - 20	
Ahead running, with the outboard pitch indicator being in a position corresponding to flank speed	350	0 - 10	3 - 30	
Same	420	0 - 45	4 - 15	
Same	480	0 - 45	5 - 00	

189

50X1-HUM

50X1-HUM

1	2	3	4	5
Ahead running, with the outboard pitch indicator being in a position corresponding to flank speed	560	1 - 00	6 - 00	See Para.5 (a,c,d)
Same	650	2 - 00	8 - 00	
Same	730	1 - 30	9 - 30	
Same	770	2 - 00	11 - 30	
Same	820	1 - 00	12 - 30	
Same	850	1 - 30	14 - 00	
Same	770	0 - 15	14 - 15	
Same	600	0 - 15	14 - 30	
Astern running, with the outboard pitch indicator being in a position corresponding to flank speed	340	0 - 10	14 - 40	See Para.5 (a,b,c,d,e)
Same	425	0 - 20	15 - 00	

Table 3

Operation rating	Crankshaft speed, r.p.m. (for installations with a variable-pitch propeller)	Duration of operation (hr, min)		Inspections
		at rating	total	
1	2	3	4	5
<u>Operation at mooring trials</u>				
Ahead running, with zero turn of the variable-pitch propeller	300	0 - 10	0 - 10	See Para.5 (a,b)
Ahead running, with the outboard pitch indicator being in a position corresponding to flank speed	350	0 - 15	0 - 25	
Same	380	0 - 20	0 - 45	
Same	420	0 - 20	1 - 05	
Same	450	0 - 20	1 - 25	
Same	480	0 - 20	1 - 45	
Same	510	0 - 30	2 - 15	
Same	560	0 - 45	3 - 00	

200

50X1-HUM

50X1-HUM

1	2	3	4	5
Astern running, with the outboard pitch indicator being in a position corresponding to flank speed	350	0 - 10	3 - 10	See Para.5 (a,b,c,d)
<u>Operation at sea trials</u>				
Ahead running, with zero turn of the variable-pitch propeller	300	0 - 10	3 - 20	
Ahead running, with the outboard pitch indicator being in a position corresponding to flank speed	350	0 - 10	3 - 30	
Same	420	1 - 15	4 - 45	
Same	480	1 - 30	6 - 15	
Same	560	1 - 30	7 - 45	
Same	650	3 - 00	10 - 45	
Same	730	2 - 30	13 - 15	
Same	770	3 - 00	16 - 15	See Para.5 (a,c,d)
Same	820	1 - 30	17 - 45	
Same	850	2 - 00	19 - 45	
Same	770	0 - 30	20 - 15	
Same	600	0 - 15	20 - 30	
Astern running, with the outboard pitch indicator being in a position corresponding to flank speed	340	0 - 10	20 - 40	
Same	425	0 - 20	21 - 00	See Para.5 (a, b, c, d, e)

When running-in the diesel engine according to Tables 2 and 3 (after the mooring trials are over), clean all the oil filters and prime the system with fresh oil, instead of the waste one. In addition to the inspections specified after running-in the engine according to Tables 2 or 3, inspect the replaced parts, and check proper functioning of the working cylinder sleeve seals (through the handholes) at a pressure of water in the system being equal to 1.5 - 2.0 kgf/cm².

After the faults detected during the running-in procedure according to Tables 2 and 3 are eliminated, the replaced parts inspected, and the sealing checked, run the final sea trials of the ship at ratings specified in Table 4.

201

50X1-HUM

50X1-HUM

Table 4

Operation rating	Minimum hours operated at the rating
Dead speed	10
Slow speed	20
Half speed	30
Full speed	30
Flank speed	20
Total	120 hours

During the final sea trials, when operating at full and flank speeds, measure all the specified parameters and write down the results into the test certificate.

The hourly consumption of fuel and oil is to be measured during operation at flank speed.

Having accomplished the final sea trials, carry out inspection of diesel engine, as specified by scheduled preventive inspection No 3 carried out after each cruise (See Chapter IV "Scheduled Preventive Inspections and Repairs"), and check (through the handholes) condition of the cylinder-and-piston assembly of cylinders whose parts have been replaced or repaired. If operation of the diesel engine and condition of the cylinder-and-piston assembly are satisfactory, the engine is considered fit for further service, and an entry to this effect must be made in the Service Log. When making the entry, write down the volume of overhauls, enumerate the replaced parts, mention the duration of running-in (the Table followed during the running-in procedure), and also the troubles detected during the running-in procedure and the final sea trials.

202

50X1-HUM

50X1-HUM

Appendix 1

MODEL P13M-4 SPEED GOVERNOR MOUNTING AND MAINTENANCE INSTRUCTIONS

1. Prime the governor with grades MK-22 or MC-20 oil, GOST 1013-49. The governor needs 4 kg of fresh and thoroughly filtered oil.

The following grades of foreign oils may be also used for the governor:

- (a) Great Britain: (BP) - Energol Diesel S2 SAE 40;
- (b) U.S.A.: (Esso Petroleum Co, Ltd) - Essolube SDX 50; (Sheel) - Rimula 40; (Texas Company) - Ursa Oil, Super Duty SAE 40

2. To prime oil, screw appliance (cup) 22-232-014 into the hole of the governor upper cover. Fill the oil by separate portions equal to the capacity of cup 22-232-014, with intervals of 8 to 10 minutes.

3. Prime the governor with oil until it reaches the central mark made on the oil level indicator. After a short period of operation, when all the governor cavities get filled with oil, the level of oil lowers down and, therefore, add oil again until it reaches the central mark of the oil level indicator.

4. During governor operation, watch to see that the level of oil does not lower down below the lower mark made on the oil level indicator.

5. Change the oil and wash the governor only on a warmed inoperative diesel engine.

To change the oil, proceed as follows:

- (a) drain the oil completely out of the governor through the lower drain plug;
- (b) fill the governor with clean diesel fuel until it reaches the upper mark of oil level indicator;
- (c) start the diesel engine and run it idle in the course of 1 to 2 minutes;
- (d) stop the engine, drain fuel out of the governor, prime the latter with fresh oil, then start the engine again and run it idle during 3 to 5 minutes;
- (e) empty the governor, and then fill it with fresh oil again.

6. During engine operation it is allowed, if necessary, to change the governor rate of irregularity, with the speed control handle position being constant; to this end, turn worm 3 (Fig.59) of the mechanism for changing the rate of irregularity, by means of a screw driver.

7. During unsteady diesel engine operation at low and idle speeds it is permissible to adjust the opening of the isodrome needle. This adjustment is to be carried out on a warmed operating diesel engine by turning the needle with the aid of a screw driver. Decrease of the isodrome needle opening improves the stability of diesel engine operation; however, too small opening of the needle increases

203

50X1-HUM

50X1-HUM

the time necessary for setting up the rating with regard to load and speed, and also increases the overspeed during abrupt reduction of load. Normal opening is within 1/3 to 1/4 of the needle turn.

Disassembly of Governor

8. Disassembly of the governor during operation is done to eliminate detected faults and to ensure periodic replacement of parts.

During disassembly of the governor it is not allowed to remove the front cover of the mechanism box, and to disturb the factory adjustment of the mechanisms mounted under the cover.

9. Disassemble (and assemble) the governor on a clean and properly illuminated table; see that the tools are clean and serviceable.

After the governor is disassembled, wash the parts thoroughly with clean diesel fuel and blow them out with compressed air.

Do not use cleaning cloth.

Partial Disassembly of Separate Units

10. Partial disassembly of the governor base with the aim of replacing the drive lower oil seal:

- (a) take the oil seal out of the base;
- (b) disassemble the oil seal to replace the leather cup.

11. Disassembly of governor scale front glass to replace the indicator pointers or to wipe the glass inner surface:

- (a) release the countersunk screws which hold the front glass frame to the housing;
- (b) remove the frame and the glass.

12. Disassembly of the corrector for washing:

- (a) screw out the four bolts that fasten the corrector cover to the body;
- (b) detach the corrector cover;
- (c) unlock and undo the corrector body screw;
- (d) take out the corrector with the spring.

13. The corrector body is to be taken out of its seat with the aim of replacing the gasket, so as to ensure proper sealing.

Take out the body only if the tightening-up of two bolts securing it to the body fails to ensure proper sealing.

14. Turn the isodrome needle body out of its seat with the aim of replacing the gasket, so as to eliminate leakage. This is to be done with the aid of a screw driver.

Take out the needle body only in case the preliminary tightening-up of the body by means of a screw driver fails to ensure proper sealing.

15. Removal of the shaft with the speed control handle.

- (a) undo the screws and detach the governor upper cover;
- (b) take out pin 13 (secured by split ring) of shaft 11 (Fig. 54b);
- (c) take the shaft with the speed indicator pointer out of bearing 10;
- (d) release the pointer coupling bolt and detach the pointer from the shaft.

16. General disassembly of the governor:

204

50X1-HUM

50X1-HUM

- (a) turn out the screws and remove upper cover 27 (Fig.54c);
- (b) unlock and take out the axes that connect fork 23 with carriage 28 and the shackle upper end;
- (c) take out speed-change sensor slide valve 31 carefully complete with the fork, spring and spring holder;
- (d) unlock and take out servo-motor lever axle 38 (Fig.54d);
- (e) screw out the coupling bolt of connecting rod 40 (Fig.54d);
- (f) screw out eight coupling bolts 9 (Fig.54d), leave the two short bolts located in the front corners of the housing, and remove the box with the mechanisms.

This will ensure access to the speed-change sensor cup, intermediate shaft elastic coupling, servo-motor piston, and isodrome piston;

- (g) take out the two short coupling bolts which fasten the housing base to the plate and the housing, then detach these parts. This will ensure access to the accumulator, and to the gears and return valves of the oil pump.

Governor Assembly and Adjustment

17. Assembly is the reverse of disassembly.

When assembling, take care to see that all the bolts and nuts are locked.

During general assembly of the governor housing, place new gaskets, if necessary.

The gaskets are to be made of tracing paper, 0.04 to 0.06 mm thick.

18. Adjusting the corrector.

Change the factory-made adjustment of the corrector during operation only if the governor is malfunctioning. When readjusting, bear in mind the following:

- (a) the adjusting washer placed between the slide valve and the spring support must be selected so that the notch made on the slide valve collar is in the center of the drain hole available in the corrector body;

- (b) the most possible precise coincidence of sizes L and ℓ (Fig.86) is obtained by adjusting the position of the slide valve nut. If the slide valve nut is adjusted wrongly, and L is larger than ℓ (the nut is overtightened), then after the corrector body nut is fitted into place, a clearance will be formed between the slide valve complete with springs, the body and its nut (Fig.87). If, however, L is smaller than ℓ (the nut is tightened up insufficiently), the spring will be clamped between the body and its nut, and a clearance will be formed between the slide valve complete with its nut and the spring supports.

No considerable clearances in the corrector are permissible;

- (c) select the free height of spring in such a way that after the slide valve nut is adjusted in compliance with the previous paragraph, the spring becomes preloaded by 2 - 3 mm.

19. Mounting the shaft with the speed control handle into place:

- (a) fit sector 12 (Fig.54b) preliminarily on bearing 10, so that the slot for pin 13 is approximately in its place in the upper position;

- (b) insert the shaft complete with the handle into bearing 10 so that notches K made on the end face of the gear of shaft 11 and on carriage toothed sector 37 (Fig.54d) align;

- (c) set the speed control handle between divisions "8" and "9" of the speed scale, engage the automatic load limiter sector with sector 12 in such a way that after pin 13 (Fig.54b) is fitted into place, automatic load limiter indicator 3 (Fig.54a) points to 80 per cent on the load scale (± 1 per cent).

205

50X1-HUM

50X1-HUM

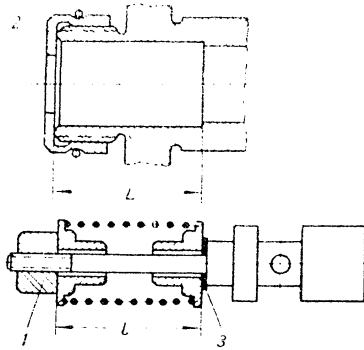


FIG. 86. ADJUSTMENT OF P13M-4 GOVERNOR CORRECTOR

1 - slide valve nut; 2 - corrector body nut;
3 - adjusting shim

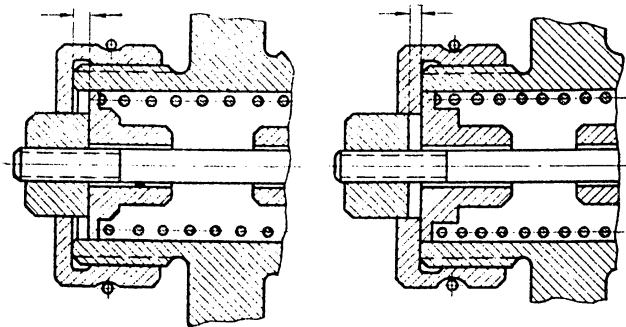


FIG. 87. ADJUSTMENT OF P13M-4 GOVERNOR CORRECTOR

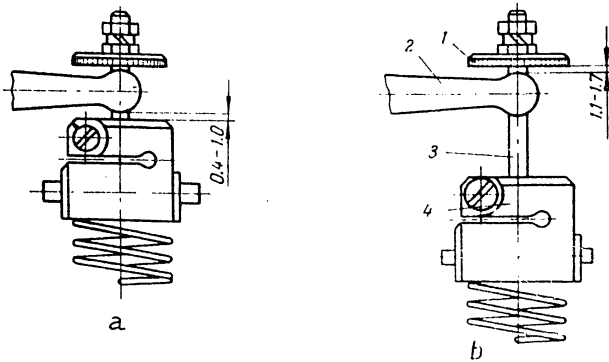


FIG. 88. ADJUSTMENT OF LEVER-TYPE LOAD LIMITER MECHANISM OF GOVERNOR P13M-4

1 - thrust plate; 2 - forked lever; 3 - rod; 4 - coupling

50X1-HUM

50X1-HUM

20. Adjusting the load limiter leverage:

- (a) carry out adjustment when the engine is standstill;
- (b) before adjusting, turn the governor control shaft by the disengaging lever in the direction to shut off the fuel feed, so that the load indicator pointer is to the left of division "0" of the load scale, and set the manual load limiter to the maximum value;
- (c) shift the speed control handle to division "2" of the speed scale. Use adjusting screw 1 (Fig. 54c) to adjust the clearance between forked lever 47 and coupling 26 of the speed change sensor, this clearance must be within 0.4 - 1.0 mm and should correspond to the values specified in the certificate (see also Fig. 88).

21. Adjusting the position of speed change sensor thrust plate:

- (a) mount the thrust plate preliminarily close to its upper position;
- (b) during the mounting procedure or trial startings, in order to provide for the possibility of adjusting the rods which link up the governor with the fuel injection pump control shaft, remove the governor upper cover with the aim of ensuring access to rod 49 (Fig. 54c), so that it will be possible, if necessary, to stop the diesel engine rapidly by pulling the slide valve upwards;
- (c) adjust the position of thrust plate 48 (Fig. 54c) with the diesel engine running idle at a speed of 250 - 255 r.p.m.

Set the manual load limiter to the maximum value. Then adjust the position of the thrust plate until a clearance equal to the value specified in the certificate is obtained between the plate and forked lever 47. The clearance should be within 1.1 - 1.7 mm (see also Fig. 88).

After adjustment is accomplished, tighten up the nut.

CAUTION! Carry out adjustment carefully, since a smallest force applied along the slide valve rod axis causes a considerable change of diesel engine speed.

22. Checking the adjustment of the leverage of the load limiter and the thrust plate of the speed-change sensor:

- (a) move the speed control handle to the 1st division of the speed scale. The engine should not stop herein;
- (b) shift the speed control handle to position STOP, in which case the engine must stop;
- (c) set the manual load limiter in some intermediate positions;
- (d) load the diesel engine, make sure that the load indicator pointer is free to align with one of the limiter pointers and that it never passes to the right of the pointers, in the directions of larger load values.

23. Replacing the speed-change sensor conical spring

- (a) when replacing the speed change sensor control spring, preload the spring with the aid of upper holder 25 (see Fig. 54c) in such a way that during diesel engine operation at full speed AHEAD rating, the speed indicator pointer occupies the same position which it had occupied before the spring was replaced;
- (b) after the speed-change sensor spring is replaced, it is advisable to check the governor control performance (calibration of spring) on a special stand;
- (c) in case it is necessary to replace the spring, with the stop, check coincidence of nominal r.p.m. at full speed AHEAD rating with the governor speed control handle being set to division 16 - 17 and coincidence of diesel engine r.p.m. at this rating with the r.p.m. measured before the replacement of the spring with the handle being set to division 16 - 17.

207

50X1-HUM

50X1-HUM

Cause	Remedy
3. Diesel engine accelerates its speed excessively during starting, idle running or abrupt reduction of load	
(a) governor or speed-change sensor drives damaged	(a) check the governor drive as indicated in Para.1c
(b) servo-motor jammed	(b) check absence of jamming in the linkage to the fuel injection pumps and in the governor servo-motor; if jamming is found, disconnect the rods from the governor servo-motor shaft, determine the place of jamming, and then eliminate the fault
4. Diesel engine fails to develop full speed with speed indicator pointer set to division "16" of speed scale	
(a) speed control mechanism dis-adjusted	(a) check connection between speed control handle and speed control mechanism; if necessary, eliminate the defect, or adjust the position of the speed-change sensor spring upper holder. Bear herein in mind that one clockwise turn of the holder changes the diesel engine speed by about 8 r.p.m.
5. Too high consumption of oil in governor	
(a) leather cup of governor driving shaft oil seal loose	(a) carry out partial disassembly of the governor base to replace the drive lower oil seal in compliance with Section "Disassembly of Governor", and eliminate the fault
6. Drive from governor to fuel injection pumps vibrates; load indicator pointer flutters considerably	
A. The vibrations are of regular nature in time with engine operation. They are usually most strongly felt at low loads and speeds	In all cases, before taking any measures, run the started engine for some period to heat the oil
(a) irregular fuel feed into diesel engine cylinders	(a) use appliance 61B-232-045 to check proper engagement between fuel injection pump racks and control rod carriers
(b) clearances in governor drive	(b) remove the governor and check free travel of coupling 14 and splined shaft 16 (see Fig.14b)
(c) speed-change sensor vibration damper jammed	(c) disassemble the governor as indicated in Para.16a, and eliminate the fault
(d) isodrome needle disadjusted, or air got into governor cavities;	(d) turn out the isodrome needle by means of a screw driver through 2 or 3 revolutions, then after 3 - 5 min turn in the needle until steady operation of engine at low r.p.m. is ensured

209

50X1-HUM

50X1-HUM

Cause	Remedy
(c) corrector jammed or its spring too weak	(c) disassemble and wash the corrector or increase the tension of its spring
B. The vibrations are of regular nature, but of lower frequency as compared to the preceding ones; they are accompanied by considerable deviation of engine speed and are most strongly felt during idle running and low loads	
(a) oil in governor contaminated or of undesirable grade	(a) change the oil and wash the governor with diesel fuel
(b) isodrome needle disadjusted	(b) adjust the isodrome needle
(c) leakage in passages of isodromic line	(c) check condition of gaskets under the corrector body and the isodrome needle body, and make sure that the isodrome needle is not misaligned
(d) corrector jammed	(d) disassemble the corrector in accordance with Para.12 and eliminate the fault
C. The vibrations are of regular nature, but high frequency vibrations prevail	
(a) speed-change sensor drive elastic coupling out of order	(a) replace the coupling spring or the coupling assembly
(b) servo-motor piston air separating hole choked	(b) change the oil and wash the governor with diesel fuel
7. Load scale glass gets misted	
(a) too much water in oil	(a) change oil in governor

Appendix 2

REMOTE CONTROL PANEL MAINTENANCE INSTRUCTIONS

1. When preparing the engine for starting after a long period of standstill (in case the panel mechanisms have not been overhauled), do the following:

- (a) If the panel has been slushed, remove the slushing compound from the panel outer surfaces and inner air pipeline, after which wipe the parts dry;
- (b) examine the panel pipes; no dints are allowed on the outer surface;
- (c) disconnect the air pipes which connect the panel with the engine from the attachment blocks, and open the panel air cocks;
- (d) admit air to the panel (at a pressure of 25 - 30 kgf/cm² to the starting valve, and at a pressure of 4 kgf/cm² to the setter), and check functioning of the panel.

2. To check the non-reversible diesel engine remote control panel for proper functioning, proceed as follows (Fig.41):

- (a) supply air to pipe union 3;
- (b) no air is allowed to flow out of pipe union 4 when the control handle is in position STOP, and also when it is shifted to the first division of zone START.

210

50X1-HUM

50X1-HUM

(c) see that air flows out of pipe union 4 when the handle is within divisions I - II of the START zone;

(d) shift the handle to division 3 within the OPERATION zone; the flow of air out of pipe union 4 must cease. Misalignment of the indicator pointer notch from the sector notch is permissible up to 3 mm;

(e) make sure that no air flows out of pipe union 4 when the handle is moved from position OPERATION to position STOP.

Panel Disassembly and Assembly

3. The panel control mechanism is to be disassembled in the following sequence:

(a) detach the panel side and front covers;

(b) disconnect the pipelines from the starting valve, slide valve of intermediate valves, and setter.

Do not detach the pipe which connects the starting valve with the slide valve of intermediate valves;

(c) remove the control handle bearing;

(d) take the control mechanism out of the body through the front handhole;

(e) detach the bearing caps and take out the shaft;

(f) unscrew its coupling nut to remove any of the plates.

4. The assembly of panel mechanisms is the reverse of their disassembly.

5. During assembly, engage the shaft gear with the toothed sector in such a way that when the shaft and the plates are in position STOP, the misalignment between the indicating pointer notch and the sector STOP notch is not in excess of 1 mm, and that the handle is free to turn without any jamming through the complete angle in both directions as far as the stop permits.

6. Prior to fitting the air pipes into place, clean them thoroughly, wash with clean diesel fuel, and scavenge with compressed air.

7. When disassembling and then assembling the panel separate mechanisms, check their timing adjustment:

(a) carry out timing adjustment of the starting valve and the slide valve of intermediate valves by varying the thickness of the shims placed between the valve (slide valve) and the plate, and also by shifting the valve (slide valve) in lateral direction;

(b) before carrying out timing adjustment of pneumatic setter, adjust the pressure in cavity B (Fig.45) within 1.2 kgf/cm^2 .

Adjust the pressure by turning nut 3. After adjustment is accomplished, secure the adjusting nut by means of a locknut. Feed herein air to pipe union 6 (Fig.41).

Timing adjustment of the setter is performed by turning tappet 17 (Fig.45) and by shifting the setter in lateral direction;

(c) when adjusting, take readings of the angles from position STOP. Carry out timing adjustment as follows:

8. Starting valve.

(a) admit air to pipe union 14 (Fig.41);

(b) no air should flow out of the pipe unions when the handle is in position STOP;

211

50X1-HUM

50X1-HUM

(c) see that air starts flowing out of pipe unions 13 and 11 when the shaft with the plates is turned through $8^{\circ}15' \pm 2^{\circ}$;

(d) at a turning angle of $12^{\circ}30' \pm 3^{\circ}$ the valve must be secured in open position. The air must flow out of pipe union 13, and an assigned air stream is allowed to flow out of pipe union 11;

(e) at a turning angle of $105^{\circ} \pm 4^{\circ}$ the latch release plate lobe must release the starting valve lever, and the valve must close. Make sure that no air flows out of pipe unions 13 and 11 in this position;

(f) shut-off the supply of air to pipe union 9. Turn the handle to the STOP direction. At a turning angle of $6^{\circ}30' \pm 2^{\circ}$ the central lobe of the latch release plate must rest against the projecting cylindrical part of the starting valve lever.

9. Slide valve of intermediate starting valves.

(a) supply air to pipe union 9;

(b) see that no air flows out of pipe union 8 when the handle is in position STOP;

(c) air should start flowing out of pipe union 8 when the shaft with the plates is turned clockwise through $34^{\circ}30' \pm 2^{\circ}$;

(d) no air is allowed to flow out of pipe union 10 during all the tests.

10. Pneumatic setter.

(a) supply air to pipe union 6;

(b) with the panel handle being set to position STOP, the pressure of air downstream of the setter, i.e. at the outlet of pipe union 7, must be within $1.3 \pm 0.1 \text{ kgf/cm}^2$;

(c) when the handle is set to division "O" within the OPERATION zone, the pressure downstream of the setter must be within $1.9 \pm 0.1 \text{ kgf/cm}^2$, and the angle of shaft turn must be $72^{\circ}20' \pm 1^{\circ}$;

(d) when the handle is on the stop (maximum angle of turn), the pressure downstream of the setter must be within $3.5 \pm 0.1 \text{ kgf/cm}^2$.

11. Check proper assembly of the panel as described above (see Paras 1, 2, 3), and then check functioning of the panel during operation of diesel engine.

Basic Troubles in Panel Operation, Their Causes and Remedies

Cause	Remedy
1. Engine fails to be started with air when panel handle is shifted to zone START	
(a) starting air pressure too low	(a) check the air pressure, charge the starting cylinders, if necessary
(b) intermediate starting valve does not open	(b) disassemble the valve, check it, and eliminate the defect
(c) starting valve remained closed (latch did not lock the valve)	(c) disassemble, and correct the latch
2. During engine starting, the crankshafts start rotating, but then stop as soon as supply of starting air is shut off	
(a) control air pressure too low	(a) check to see that no air is leaking, and ensure supply of air at a pressure of $4 \pm 0.2 \text{ kgf/cm}^2$

50X1-HUM

50X1-HUM

(b) setter air outlet pressure insufficient

Check for pressure and eliminate leakage, if any. If the setter is faulty or damaged, disassemble and repair it. Check functioning of the setter in compliance with Para 10 "Pneumatic setter".

Appendix 3

INSTRUCTIONS FOR MOUNTING AND MAINTENANCE OF TYPE CAU 24B-58 SIGNALLING SYSTEM INSTRUMENTS

1. Carry out wiring in accordance with the Cable Diagram (Fig.65)
 2. To connect the circuit elements, use grades KHPH 2x1 and KHPH 7x1 cable. Grade KHPH cable may be also used. After the cable is fitted into the instrument gland, terminate the cable ends. See that the rubber sealing rings are fitted correctly on the cable, and that the cable is not free to travel axially in the gland. Seal the gland outside by means of cable putty.
 3. The strands led into the instrument are to be connected to respective terminals by means of rings made of cable strands and provided with a tinned contact surface.
 4. To connect the cable strands inside the signal panels, follow the circuit wiring diagrams available on the panel covers.
 5. After the panel is mounted, check all the groups with the aid of the control switch whose contacts imitate operation of the sensors.
 6. To energize the signalling system during preparation of diesel engine for starting, turn packet-type switch PANEL SUPPLY (ВСТАВЬТЕ ПИЗЛТА) to position ON. The green lamp must come up in this case.
- Note. If the engine is inoperative due to absence of pressure in the oil, fuel and water pipelines, the tell-tale and emergency lamps will come up.
As soon as the engine is started, the lamps must extinguish (provided the systems are intact).
7. After the engine is started, set the SOUND SIGNAL (ЗВУКОВОЙ СИГНАЛ) packet-type switch in position ON. This will energize the bell, in which case the BELL OFF (ОТБЕЖКА БУДУЩЕГО) white lamp must come down. To cut the system out, follow the reverse order.

Basic Troubles in Operation of Signalling System. Their Causes and Remedies

Cause	Remedy
-------	--------

Combination relay KP-1 with temperature control

1. No signal comes up, though the temperature of regulated medium has reached the maximum value

(a) relay disadjusted

Adjust the relay in accordance with the instructions available in the manual.

213

50X1-HUM

50X1-HUM

Cause	Remedy
(b) thermal system leaky, or micro-switch damaged	(b) replace the temperature relay
(c) one of the conductors disconnected	(c) check connection of conductors
2. Excessive range of insensitivity, or considerable deviation of operation temperature	
(a) rods jammed, or micro-switch damaged	(a) replace the temperature relay
<u>Combination relay KP-1 with pressure sensor</u>	
3. No signal comes up, though the pressure of adjusted medium has reached the maximum value	
(a) relay disadjusted	(a) adjust the relay in accordance with instructions available on the relay cover
4. Excessive range of insensitivity, or considerable deviation of operation pressure	
(a) rod jammed	(a) replace the minimum pressure relay
(b) friction in mechanical system	(b) replace the minimum pressure relay
(c) micro-switch faulty	(c) replace the minimum pressure relay
<u>Signal panel</u>	
5. Green (or red) lamp fails to come up, though supply has been cut in by PANEL SUPPLY switch	
(a) lamp blown	(a) replace the lamp
(b) switch damaged	(b) inspect and correct the switch
(c) fuse blown	(c) replace the fuse
6. Working condition green tell-tale lamp does not get switched over to red lamp after signalling system sensor operates	
Tell-tale lamps do not come up	
(a) individual point relay faulty	(a) set the control switch to the No. of this group (the groups are counted in accordance with the location of tell-tale lamps on the panel, beginning with the right-hand upper lamp). If this fails to ensure a change of signals, replace the relay
(b) external circuit wires out of order	(b) check the wiring and eliminate the fault
7. Red lamp or decoding tell-tale lamp does not come up after signalling system sensor operates	
(a) lamp blown	(a) replace the lamp
(b) some individual point relay contacts burnt	(b) clean the contacts

50X1-HUM

50X1-HUM

Warning Signalling

Sensor	Operation	Location
Minimum fuel pressure relay	At fuel pressure below 1.0 kgf/cm ²	On engine, on pipeline upstream of high-pressure pump (downstream of filter)
Minimum oil pressure relay	At oil pressure below 1.0 kgf/cm ²	In system, on engine oil supply pipe (delivery line downstream of filter)
Minimum fresh water pressure relay	At water pressure below 0.25 kgf/cm ²	In system, on engine water supply pipe (downstream of cooler)
Engine oil outlet temperature relay	At oil outlet temperature above 90°C	In system, on scavenging line pipe (upstream of filter)
Engine fresh water outlet temperature relay	At water outlet temperature above 80°C	In system, on engine water outlet pipe (upstream of pump)

Appendix 4

SPECIFICATIONS OF FUEL

Specifications	GOST and values for various grades			Test methods
	GOST 4749-49		GOST 305-62 C	
	ДГ	ДЛ		
1	2	3	4	5
Cetane number	50	45	50	GOST 3122-52
Fractional composition:				
50 per cent is distilled at a maximum temperature of °C:	280	290	280	
90 per cent	-	350	-	
96 per cent	340	-	-	
98 per cent	-	-	340	GOST 33-66
Kinematic viscosity at 20°C, c.st.	-	3.5-8.0	4.5-8.0	
Kinematic viscosity at 50°C, c.st.	2.5-4.0	-	-	
Coking capacity of a 10-per cent residue, per cent (max)	0.5	0.5	-	GOST 5987-51
Maximum acid number, mg per 100 ml of fuel	5	5	5	GOST 5985-59
Maximum ash content, per cent	0.02	0.02	0.01	GOST 1461-59

215

50X1-HUM

50X1-HUM

1	2	3	4	5
Maximum content of sulfur, per cent	0.2	0.2	1.0	GOST 1771-48
Copper strip test		withstands		GOST 6321-52
Minimum closed-cup flash point, °C	90	60	90	GOST 6356-52
Maximum congealing point, °C	- 15	- 10	- 15	GOST 1533-42

Appendix 5

SPECIFICATIONS OF OIL M-20F ACCORDING TO LOCAL STANDARD JETTY 12H No.24-63

Specifications	Values	Test method
Kinematic viscosity at 100°C, c.st.	20 ± 0.5	GOST 33-66
Minimum ash content, per cent	1.45	GOST 1461-59
Maximum content of mechanical impurities, per cent	0.03	GOST 6370-59 (and washing the filter additionally with hot water)
Maximum water content	"traces"	GOST 2477-65
Minimum open-cup flash point, °C	245	GOST 4333-65
Maximum congealing point, °C	- 15	GOST 1533-42
Oil coking capacity	up to 0.45	GOST 5987-51

Appendix 6

MOUNTING AND OPERATION CLEARANCES

Description of clearance	Set clearance during mounting, mm		Maximum permissible during operation
	min.	max.	
1	2	3	4
<u>Crankshaft bearings</u>			
Diametral clearance in main bearings (as measured with feeler gauge)	0.13	0.28	0.40
Clearance under lower crankshaft in main bearings (as measured with feeler gauge)	0.00	0.03	-
Side radial clearances (at joints) of main bearings at a distance of 30 mm from the joint face:			
for half-bushes located above the joint face	0.07	0.30	

50X1-HUM

50X1-HUM

1	2	3	4
for half-bushes located below the joint face (the difference between the clearances in horizontal plane on one side of the shaft should not exceed 0.07 mm)	0.05	0.25	-
Diametral clearance in crankpin bearing (as measured with feeler gauge)	0.11	0.24	0.40
Axial clearance of crankshaft in thrust bearing (as measured with feeler gauge)	0.2	0.4	0.8
<u>Working cylinder sleeve</u>			
Clearance between cylinder sleeve complete with jacket and frame along the locating collars (from top to bottom):			
collar I, dia.320 - along the sleeve flange	0.09	0.225	
collar II, dia.318 - along jacket top	0.020	0.09	
collar III, dia.315 - along jacket bottom	0.020	0.09	
collar IV, dia.263 - along sleeve bottom	0.09	0.175	
Clearance between piston guiding part and cylinder sleeve (difference between maximum diameter of piston and minimum diameter of sleeve)	0.32	0.435	0.7
<u>Piston, connecting rod</u>			
Diametral oil clearance in end bearing (in vertical plane), as measured with feeler gauge	0.19	0.26	0.40
Diametral clearance between piston pin and piston insert hole	negative allowance 0.005	clearance 0.050	-
Axial play of connecting rod in piston insert, as measured with feeler gauge	0.5	0.7	1.0
Diametral clearance between piston trunk and insert along the centring collars (as measured):			
along upper collar	0.02	0.10	-
along lower collar	0.06	0.15	-

217

50X1-HUM

50X1-HUM

1	2	3	4
Clearance between compression ring and piston groove (in width), as measured with feeler gauge	0.12	0.17	0.40
Clearance between protective ring and piston groove (in width), as measured with feeler gauge	0.05	0.11	0.40
Gap of compression and piston rings:			
compressed gap (according to feeler gauge)	1.7	1.9	4.0
free gap	21	24	at least 18
Clearance between oil-control rings and piston groove (in width), as measured with feeler gauge	0.05	0.13	0.20
Oil-control ring gap:			
compressed gap (according to feeler gauge)	1.3	1.8	5.0
free gap	21	24	at least 18
Distance between piston heads (according to pressed-out lead)	3.0	3.5	-
<u>Camshaft bearings</u>			
Camshaft bearing diametral clearance measured with feeler gauge	0.06	0.11	0.25
Axial play of camshaft in thrust bearing	0.4	0.7	1.00
<u>Main drive</u>			
Diametral clearance in bearings of upper and lower gear shaft journals, as measured with feeler gauge	0.3	0.4	0.6
Diametral clearance in bearings of gear shaft journals (as measured with feeler gauge)	0.2	0.3	0.5
Axial clearance (total) in thrust bearing	0.5	0.7	1.0
Axial clearance of intermediate shaft	2.0	7.0	-
<u>Major accessories drive</u>			
Backlash between teeth of 2nd stage driven gear and last intermediate one	0.17	0.42	
Backlash between teeth of fluid coupling drive intermediate gears	0.21	0.45	increase of clearance by 0.1, as compared to specified values
Backlash between teeth of first intermediate and driving gears of fluid coupling drive	0.21	0.45	

218

50X1-HUM

50X1-HUM

	2	3	4
Backlash between teeth of 1st stage driven gear and oil pump drive gear	0.21	0.35	
Backlash between teeth of oil pump drive gear and 1st stage driving gear	0.25	0.52	
Backlash between teeth of 1st stage driving gear and water pump drive gear	0.25	0.52	
Diametral clearance in bearings of fluid coupling drive gear shaft, as measured with feeler gauge	0.17	0.21	0.3
Diametral clearance in bearings of 1st stage driving gear shaft	0.17	0.27	0.4
Diametral clearance in bearings of water pump drive gear shafts, as measured with feeler gauge	0.06	0.10	0.20
Diametral clearance in bearings of shafts of other gears, as measured with feeler gauge	0.08	0.14	0.30
Total axial clearance in thrust bearings of 1st stage driving gear and oil pump gear	0.20	0.50	0.70
Total axial clearance in thrust bearings of water pump drive gears and 1st stage driven gear	0.25	0.60	1.0
Total axial clearance in thrust bearings of other gears	0.5	1.00	1.5
Axial clearance of torsion shaft	3	9	-
<u>Double-section oil pump</u>			
Axial play of taper roller bearings (as measured)	0.06	0.10	-
Radial clearance between gears and housing (as measured)	0.12	0.16	0.3
Axial clearance between gears and housing, with the shaft being pressed to the extreme position (as measured)	0.05	0.10	-
<u>Turbo-supercharger</u>			
Diametral clearance in supporting bearing of turbo-supercharger rotor shaft journal (as measured with feeler gauge)	0.30	0.375	0.5
Diametral clearance in supporting and-thrust bearing of turbo-supercharger rotor shaft journal (as measured with feeler gauge)	0.30	0.375	0.5

219

50X1-HUM

50X1-HUM

5th place - letters H or K' showing the part position with regard to diesel engine length:

H - bow;

K' - stern.

For example, stamp 7H18BH put on the crankshaft half-ring will be interpreted as follows:

7 - number of diesel engine;

H - lower crankcase;

18 - 18th mount;

B - upper half-ring;

H - bow side.

Note. The number of indexes used to mark the units and parts must be as small as possible, but sufficient enough for determining the position of the part on the diesel engine.

III. Marking of diesel engine main units and parts:

Unit or part	Place for stamping	Stamp
Crankshafts	Side surface of 1st crank	Lower shafts H1, H11 Upper shafts B1, B11
Torsion shafts	End face of stern side	Same
Working cylinder sleeve	Flange, timing side	1, 2, 3, 4, etc.
Exhaust manifold sections	Outer flange surface	Same
Exhaust manifold section spacer	Side surface	Same
Spacing plate of working cylinder sleeves	Same	Same
Working piston	Trunk bottom end face, bow side	Upper pistons B1, B2, B3, B4, etc. Lower pistons H1, H2, H3, H4, etc.
Piston inserts	Lower end face of bow side	Same
End bearing bushing	Bow side end face	Same
Piston pins	Bow side end face	Upper pistons B1, B2, B3, etc. Lower pistons H1, H2, H3, H4, etc.
Connecting rod blade	Lower support, side surface of timing side	Same
Big end	Side surface of timing side	Same
Big end bush	Outer side end face	Same
Big end cap	Bow side surface	Same
Compression plate	Bearing surface	Same
Main bearing cap	Side surface of timing side	Upper pistons B1, B2, B3, etc. Lower pistons H1, H2, H3, etc.
Main bearing bushes (upper and lower half-bushes)	Outer side end face	Upper bearings B1, B2, B3, etc. Lower bearings H1, H2, H3, etc.

222

50X1-HUM

50X1-HUM

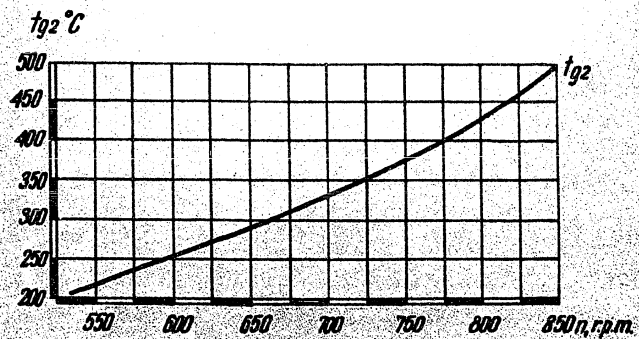


FIG. 89. CHART SHOWING CHANGE OF EXHAUST GAS TEMPERATURE UPSTREAM OF TURBINE DEPENDING ON SPEED AT PROPELLER PERFORMANCE (ULTIMATE VALUES)

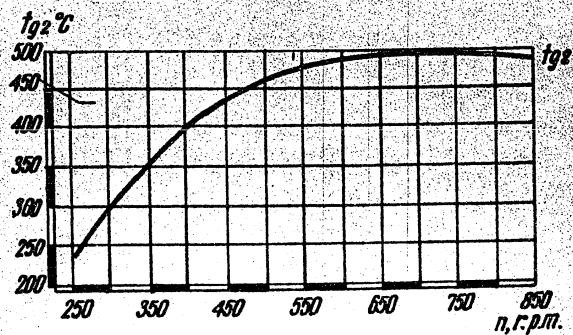


FIG. 90. CHART SHOWING CHANGE OF EXHAUST GAS TEMPERATURE UPSTREAM OF TURBINE DEPENDING ON SPEED AT LIMITING PERFORMANCE (ULTIMATE VALUES)

50X1-HUM

50X1-HUM

Unit or part	Place for stamping	Stamp
Camshafts	Side surface of attachment flanges	Starboard row П (right-hand) Portside row Л (left-hand)
Camshaft bearings	End face, bow	Starboard row П1, П2, П3, etc. Portside row Л1, Л2, Л3, etc.

Appendix 9

CHARTS SHOWING CHANGE OF EXHAUST GAS TEMPERATURE UPSTREAM OF TURBINE DEPEND-
ING ON SPEED AT PROPELLER AND LIMITING PERFORMANCE

(See Figs 89, 90)

Appendix 10

DIESEL ENGINE UNIVERSAL PERFORMANCE WITH REGARD TO RELATIVE HOURLY CONSUMP-
TION OF FUEL

During diesel engine operation at any rating its power is determined with a quite sufficient accu-
racy by the relative hourly consumption of fuel.

The relative hourly consumption of fuel is determined from the formula:

$$K = \frac{G_f}{G_{fn}} \text{ (see Fig. 91), where}$$

G_f - hourly fuel consumption measured at this particular rating;

G_{fn} - hourly fuel consumption at nominal rating, as specified in the diesel engine Service Log,
and brought to ship's conditions (depending on heat capacity, intake temperature and exhaust back-
pressure as indicated in Para. 71, Chapter II).

The engine power is calculated from the determined value of relative hourly consumption of fuel
(K) and diesel engine speed (n) at this particular rating.

Note. The fuel consumption is to be checked at diesel engine constant speed and load (with the sea
being smooth or slight, and the ship's course straight). Measure the fuel consumption at least
three times, then calculate the mean result, so as to avoid errors.

Appendix 11

INSTRUCTIONS FOR REMOVING CARBON FROM PISTONS

To remove carbon from pistons, apply chemical and mechanical methods, and strictly follow
the directions given in the instructions below.

Chemical cleaning is done with a 15-per cent alkali solution of caustic soda (NaOH) or caustic
potash (KOH) in water.

Preparing the Solution

1. Weigh up the necessary amount of alkali (in compliance with the capacity of the bath).
2. Fill half the bath volume with cold water, and add the alkali carefully into it.
3. Add water up to the working level, stir the solution and heat it up to a temperature of 90°
to 100°C.

Note. Arrange exhaust ventilation above the bath with the alkali solution.

50X1-HUM

50X1-HUM

First Method

When applying this method, remove the oil cooler from its seat and disassemble it as described in Section A. To carry out washing, submerge the cooling element with the body into a tank with chemical solution. Use carbon tetrachloride or gasoline as solvent.

The use of gasoline is undesirable for fire-prevention reasons. To wash the cooling sections with carbon tetrachloride solution, proceed as follows:

1. Dip the cooling element with the body into the tank with solvent and keep it there in the course of 10 to 15 minutes. During this period lift and lower the section several times to wash the pipes (until clarified solvent starts flowing out of the pipes).
2. Arrange the cooling element with the body above the tank and force solvent through each pipe by means of a gun with a spout having the shape of the pipe slot.
3. Wash the cooling element with the body by submerging it into hot water, after which place it vertically so that water drips down.
4. Examine the pipe ends. If the pipe ends are choked with hard particles, remove the particles with the aid of a metal needle, or by scavenging the pipe with compressed air, after which wash the cooler with hot water again.
5. Assemble the cooler and pressure-test the oil cavity with motor or solar oil at a pressure of 8 kgf/cm^2 for 5 minutes. No leakage is permissible.

Second Method

With this method applied, the cooler needn't be disassembled; the cooler pipes are washed by means of a special stand whose diagram is presented in Fig. 94.

Washing is to be carried out in the following sequence:

1. Dismount the cooler from its seat and drain the oil out of the pipes (or do not dismount the cooler, and use flexible hoses to drain the oil).
2. Mount the cooler on the washing stand and connect the cooler oil system to the circulating system, as indicated in Fig. 94.
3. Use pump 2 to force washing solution through the cooler pipes for 30 minutes in the direction opposite to the oil flow, and for 30 minutes in the direction of oil flow.

The water solution used for washing should contain 4 per cent of oxidized petrolatum (Specifications BTY3 45-50) and 5 per cent of caustic soda. The temperature of the solution must not be lower than 93°C and the velocity of its flow through the cooler pipes should be within 1.3 - 1.6 m/sec. (To wash the cooler, use a pump with a capacity of 140 - 180 m^3/hr).

4. Pump hot water (not lower than 80°C above zero) through the cooler pipes in the course of 15 to 20 minutes.
5. Remove the covers from the cooler and scavenge the pipes with compressed air until water is forced out of the pipes.
6. Examine the pipe ends. If the pipe ends are choked with hard particles, remove the particles with the aid of a metal needle, or by scavenging the pipes with compressed air. Fit the covers into place.
7. Pressure-test the cooler oil cavity hydraulically by means of motor or solar oil at a pressure of 8 kgf/cm^2 for 5 minutes. No leakage is permissible.

50X1-HUM

50X1-HUM

To tighten up the nuts during assembly of connecting rod, proceed as follows:

Before tightening the nuts up, coat the thread with clean oil used for lubricating the diesel engine (during the first assembly of the connecting rod, lubricate the thread with industrial castor oil, GOST 6757-53).

Tighten up the stud splined nuts preliminarily right home with a force applied by one hand to wrench 47B - 232-303 with a 200 mm long arm, then tighten them up finally through 5 - 6 splines by means of wrench 47B - 232-304 with a 700 mm long arm. Tighten up the nuts in two motions alternately along a diagonal line (after each nut is tightened up through 2 splines).

Tighten up the connecting rod bolt nuts preliminarily as far as they will go with a force applied by one hand to wrench 47A - 232-074 with a 200 mm long arm, then tighten them up finally through 3/4-1 flat. Carry out tightening in two motions, alternating herein the nuts located along a diagonal line (after each nut is tightened up through 1/2 of a flat).

Having tightened the nuts respectively through 4 splines or 3/4 of a flat, tighten them up additionally through not more than 1 spline (or 1/4 of a flat) so as to align the nut slots with the holes for cotter pins.

The above ranges of tightening up the nuts ensure alignment between the nut slots and the holes for cotter pins.

After the nuts are tightened up, make sure that no clearances are left in the joints between the connecting rod blade and cap with the big end; a 0.03 mm thick feeler gauge should not pass.

To check tightening of the nuts, in case when they are being tightened up by means of wrenches 47B - 232-303 and 47B - 232-304 which have no notches, make 30 notches uniformly spaced over the circumference on the outer surface on both sides of the heads (against the teeth of the internal splines, respectively).

In case of wrenches 47A - 232-074 and 47A - 232-076 are used, make 6 notches located respectively against the hexahedron corners of the heads.

To ensure tightening-up of the nuts within the above ranges, tighten up the nuts preliminarily as far as they will go, and then mark the position of the spline or hexahedron corner (of each nut) relative to the big end by making chalk notches on the nut and head.

When tightening up the nuts during assembly of connecting rods, never apply extensions to the handles of specified wrenches, and never use non-specified wrenches.

Appendix 14

INSTRUCTIONS FOR APPLICATION OF TYPE F3H-150/B GLUE FOR FITTING THE RUBBER RINGS ON CYLINDER SLEEVES

These instructions elucidate the application of glue F3H-150/B when inserting the diesel engine working cylinder sleeves into the frame, so as to prevent wear of rubber sealing rings.

The sealing glue called elastomer F3H-150/B, Specifications ТУМУП No. П-105-58, consists of butadiene-nitrile rubber CKH-40 and resin БДУ.

It is produced by the industry in the form of rolled plates of dark-brown colour. The glue is used for attaching rubber to metal, to ensure sealing, and also as an elastic protective coating against corrosion, cavitation and fretting. The range of its working temperatures is within -70° to $+150^{\circ}\text{C}$. The glue is resistant to oils, gasoline and water.

50X1-HUM

50X1-HUM

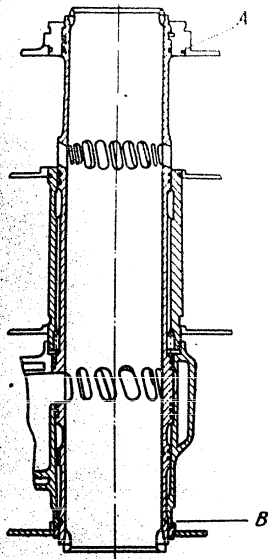


FIG. 95. FITTING THE SLEEVES
INTO DIESEL ENGINE FRAME

2. Fit the sleeve into the frame not earlier than one hour after the rubber rings were glued. Before fitting the sleeve, apply solid oil or liquid soap to the locating collars of the frame and the exhaust manifold section.

3. Final adherence of glue to metal and rubber will take place after 3 - 5 hours of engine operation, when the temperature of metal surface increases.

Appendix 15

INSTRUCTIONS FOR PREPARATION OF GRADE H3Л PUTTY

The putty is designed for sealing the turbine joint faces.

Composition of Putty

- | | |
|-------------------------------------|--------------------|
| 1. Asbestos crumb (asbestite) | 500 g |
| 2. Cement | 200 g |
| 3. Soluble glass | about 1 - 1.5 lit. |
- (until the necessary consistency is obtained)

Preparing the Putty

1. Mix the weighed portion of asbestos crumb and cement thoroughly.
2. Add soluble glass into the obtained mixture, and stir until it acquires the necessary paste-like consistency.
3. Store the prepared putty in a tightly closed container, to prevent its untimely solidification.
4. Apply the putty to the turbine mating surfaces by means of a spatula.

Appendix 16

LIST OF MEASURING INSTRUMENTS AND AUTOMATIC SYSTEM DEVICES DELIVERED WITH DIESEL ENGINE

Nos	Instrument	Position of red line	Qty per engine	Standards	Notes
1	2	3	4	5	6
1	Pressure gauge MTK-100Bx60, accuracy class 2.5 (for starting air)	30	1	MPTV5.954-11024-66	On instrument board (near engine)
2	Pressure gauge MTK-100Bx10, accuracy class 2.5 (for oil)	6	1	Same	Same
3	Pressure gauge MTK-100Bx6, accuracy class 2.5 (thermoregulation and control)	4.2	1	Same	Same

236

50X1-HUM

50X1-HUM

1	2	3	4	5	6
4	Pressure gauge MTK-100B x6, accuracy class 2.5 (for fuel)	3	1	MPTV5.954-11024-66	On instrument board (near engine)
5	Pressure gauge MTK-100B x4, accuracy class 2.5 (for fresh and sea water)	-	2	Same	Same
6	Model 082 distance thermometer, 0 - 120°C, L=12,000 mm (for outlet water)	75	1	TV-03-118-66	Same
7	Model 082 distance thermometer, 0 - 120°C, L=12,000 mm (for outlet oil)	85	1	Same	Same
8	Electric tachometer K16, including: (a) tachometer generator MЭT 8/30 for 1,500 r.p.m. (b) tachometer indicator M-186, 0 - 1000	- 850	1 2	TV 648-3528-56 MPTV5.648-3551-64	On engine One on instrument board
9	Exhaust gas temperature measuring instruments, including: (a) millivoltmeter MГ-80, 0 - 600°C; (b) millivoltmeter MГ-80, 0 - 600°C; (c) thermocouple TXK-400M with compensating wire, version 366.4802.43, L=7,950 mm (d) thermocouple TXK-400M with compensating wire, L = 17,500 mm	480 500 - -	16 4 18 2	TV 575-1290-52 Same MPTV5.958-8966-62 Same	On instrument board Two on control panel and two on instrument board On engine Same
10	Summating revolution counter 821.01	-	1	TV-953-362-57	Same
11	Pressure gauge ЭДМВ-80, type 1, 0 - 80 kgf/cm ² (for starting air)	30	1	TV per No.19077	On control panel
12	Pressure gauge ЭДМВ-6, type 1, 0 - 10 kgf/cm ² (for oil)	6	1	Same	Same

237

50X1-HUM

50X1-HUM

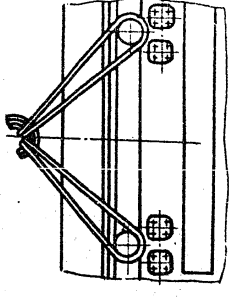
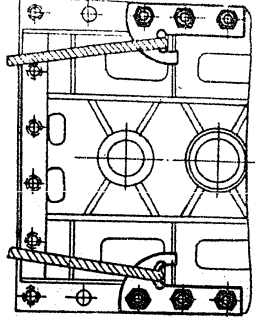
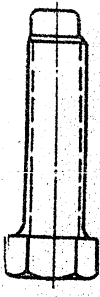
1	2	3	4	5	6
13	Pressure gauge ЭДМВ-6, type 1, 0 - 6 kgf/cm ² (for fresh and sea water)	-	2	TV per No.19077	On control panel
14	Maximum pressure indicator 1711, 160 kgf/cm ²	110	2	БТУ-000-102	For periodic measurements on diesel engine
15	Marine-type thermometer TK-100-100	-	2	БТУ 34-58	Same
16	Pressure gauge МТК-100Бx6, accuracy class 2.5	-	1	МРТВ5.954-11024-66	To check the pneumatic setter
17	Signal panel	-	1	4ПВ-310-001	Pertain to the set of signalling system
18	Signal box	-	1	4ПВ-310-002	CAC.24B -55
19	Combination relay KP-1 with temperature sensor:				Same
	(a) with a setting above 90°C (for oil)	-	1	РТВ 30GP 852-60	Same
	(b) with a setting above 80°C (for water)	-	1	Same	Same
20	Combination relay KP-1 with pressure sensor set up for operation:				
	(a) at a drop of pressure below 1 kgf/cm ² (for oil and fuel)	-	2	Same	Same
	(b) at a drop of pressure below 0.25 kgf/cm ² (for fresh water)	-	1	Same	Same
21	Combined bell-and-howler КЛПН-24		1	МРТВ5.667-7008-65	Same

238

50X1-HUM

50X1-HUM

LIST OF MOUNTING TOOLS AND APPLIANCES

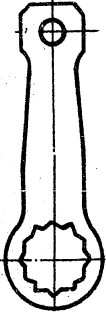

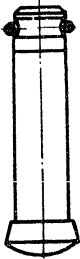
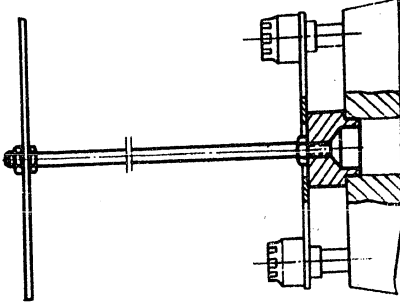
Designation	Name of tools and appliances	Drawing
1	2	3
47B-232-091	Engine lifting fixture assembly	
47A-232-033	Fixture to lift the major accessories drive	
47B-232-150	Throw-out bolt for diesel engine frame	

239

50X1-HUM

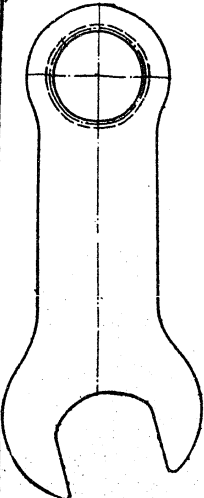
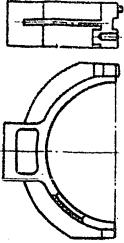
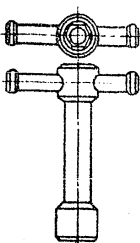
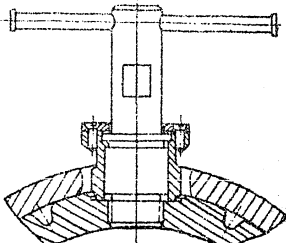
50X1-HUM

240

1	2	3
47B-232-498	Wrench for nuts fastening the frame mounts	
47B-232-035-1	Handle for wrenches of jack bolt and locknut	
47B-232-189	Appliance for removing the main bearing bush	
47H-232-090	Protective rod for the connecting rod big end	

2

50X1-HUM

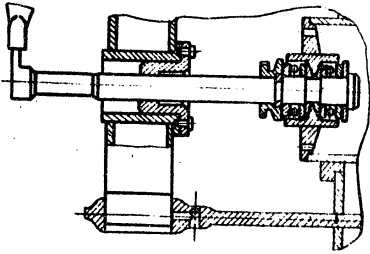
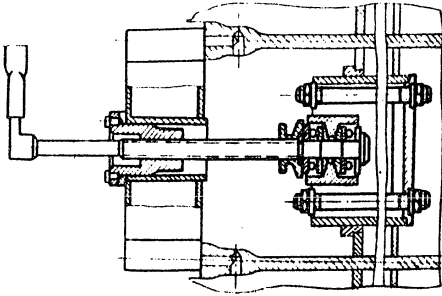
1	2	3
<p>47B-232-259 47B-232-363</p>	<p>Wrench for jack bolt Wrench for jack locknut</p>	
<p>47H-232-034</p>	<p>Appliance for inserting the main bearing bush</p>	
<p>47H-232-070</p>	<p>Wrench for fastening the working cylinders</p>	
<p>47A-232-095</p>	<p>Appliance for locking the jacket when pressing the working cylinder sleeve into the frame</p>	

50X1-HUM

241

50X1-HUM

50X1-HUM

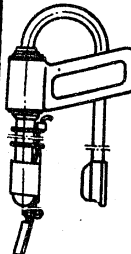
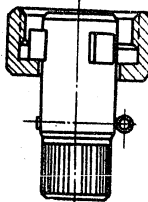
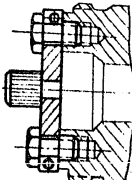
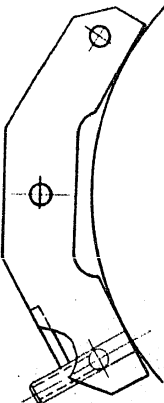
1	2	3
47A-232-079	Puller to press in the working cylinder sleeve	
47A-232-079	Puller to press out the working cylinder sleeve	

242

2


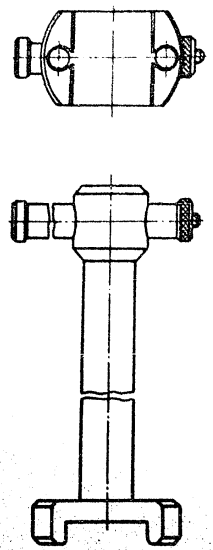
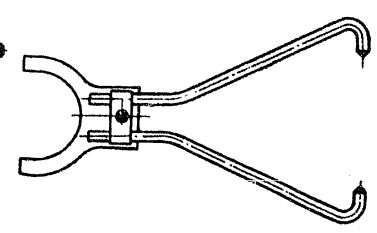
50X1-HUM

50X1-HUM

1.	2	3
47Д-232-080	Appliance for inspecting the working cylinder sleeve	
47Е-232-097	Appliance for screwing-in the injector pipe union	
47Е-232-088	Appliance for screwing-in the injector flange	
47Д-232-094	Appliance to check proper mounting of injector pipe union	

50X1-HUM

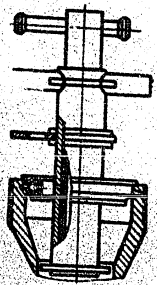
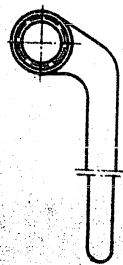
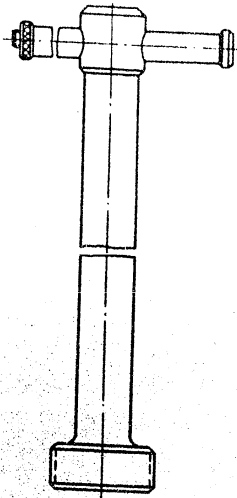
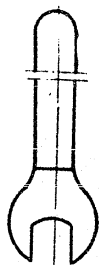
244

1	2	3
61B-232-003	Wrench for screwing-in the injector pipe union	
61B-232-014	Wrench for starting valve pipe union	
47A-232-091	Appliance to hold the washer of working cylinder starting valve flange	

50X1-HUM

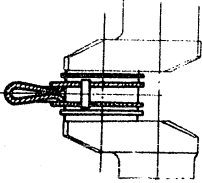
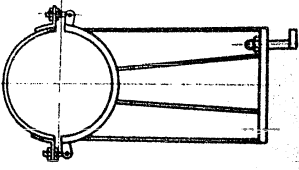

2

50X1-HUM

1	2	3
47A-232-081	Appliance for mounting the intermediate shaft of the main drive	
47A-232-093	Bent wrench for main drive splined nuts	
61B-232-016	Torsion shaft extension	
47B-232-493	Wrench for exhaust manifold thermocouple nuts	

50X1-HUM

50X1-HUM

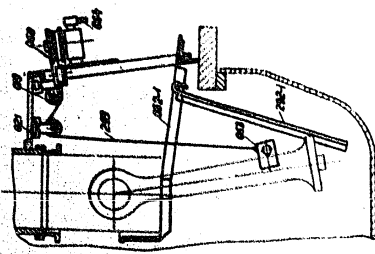
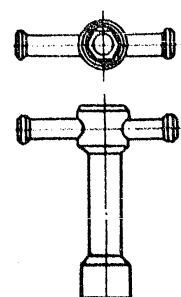
1	2	3
47B-232-185	Crankshaft lifting clamp	
47B-232-016	Appliance for laying the crankshaft when disassembling the engine on the object	
47A-232-167	Appliance for holding the upper piston	

246

2

50X1-HUM

50X1-HUM

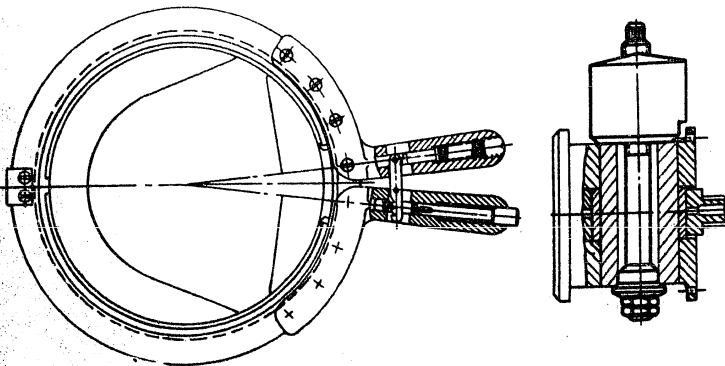
1	2	3
47A-232-049- -1 47A-232-019 47A-232-021 47A-232-053 47A-232-060 47A-232-500 47A-232-064 47A-232-262-1 47A-232-293	Appliance for taking the lower piston out through the lower crankcase Suspension pulley Suspension pulley Grip assembly Winch Carriage for pistons Handle Trough Wire rope	 
	47A-232-072	

247

50X1-HUM



248

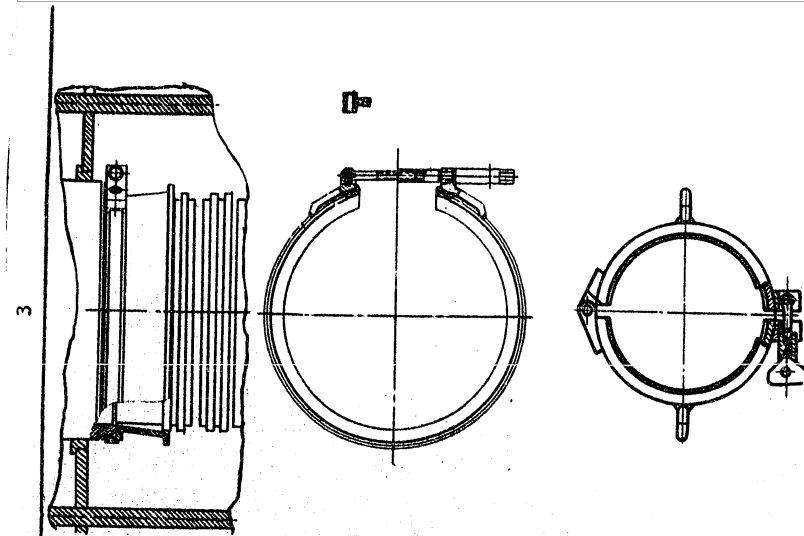
1	2	3
61B-232-039	Compression piston ring remover and inserter	
47B-232-194	Remover to press the pins out of piston insert	

50X1-HUM

3

50X1-HUM

50X1-HUM



Appliance for fitting the pistons
into cylinders

Piston lifting fixture

61E-232-027

47A-232-083

840

50X1-HUM

50X1-HUM

250

1

2

3

47D-232-099

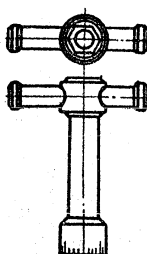
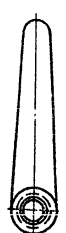

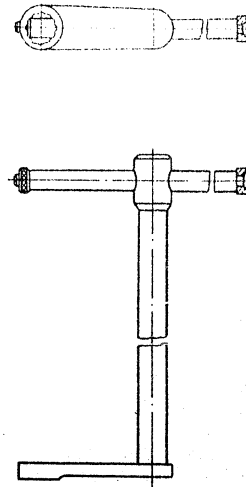
Working cylinder sleeve lifting
fixture

47B-232-049

Puller to press out the connect-
ing rod end bearing bushing

47D-232-089

Puller to press out the connecting rod
end bearing pin

		50X1-HUM	
2	3		
47H-232-074 47H-232-076	Wrenches for connecting rod bolt nuts (long and short)		
47E-232-303	Wrench (short) for connecting rod splined nuts		
47E-232-304	Wrench (long) for connecting rod splined nuts		
61E-232-007	Wrench to fasten the fuel injection pump		
		251	

47A-232-074
47A-232-076

Wrenches for connecting rod bolt
nuts (long and short)

47B-232-303

Wrench (short) for connecting rod
splined nuts

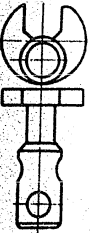

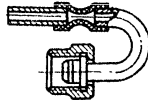
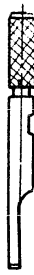
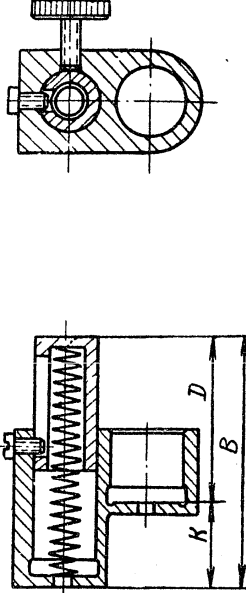
47B-232-304

Wrench (long) for connecting rod
splined nuts

61B-232-007

Wrench to fasten the fuel injection
pump

252

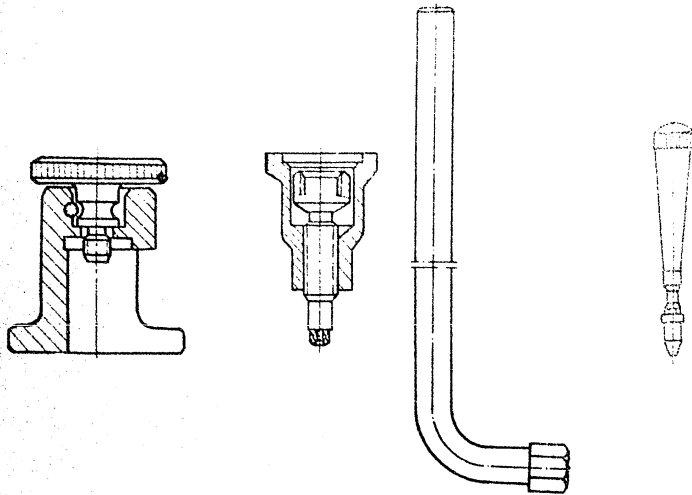
1	2	3
47B-232-191	Wrench for union nuts of high-pressure fuel pipes	
47B-232-356	Wrench for the nuts that secure the fuel cam plates	
47B-232-055	Appliance for adjusting the fuel injection pumps against meniscus	
47B-232-130	Gauge to determine the position of fuel injection pump plunger	
61B-232-045	Appliance for determining the position of fuel injection pump racks	

50X1-HUM

3

50X1-HUM

50X1-HUM



Stop for adjusting the fuel injection pumps (for zero feed)

Puller for pressing out the fuel injection pump delivery valve

Wrench for assembling and disassembling the injector

Appliance for cleaning the injector nozzle orifices

47A-232-012

47A-232-321

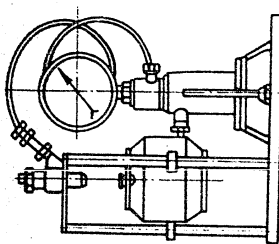
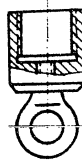
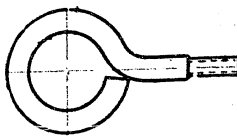
61B-232-210

25-232-551

153

50X1-HUM

50X1-HUM

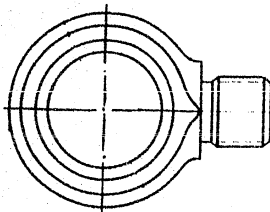
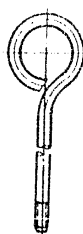
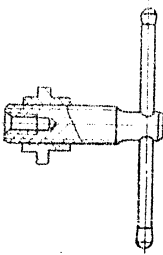
1	2	3
47A-233-001	Injector checking stand	
47A-232-043	Eye-bolt for lifting the turbo-supercharger rotor	
47A-232-495	Eye-bolt to remove the injector pressure block	

254

3

50X1-HUM

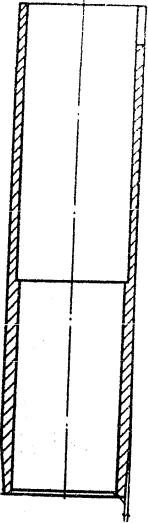
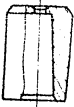

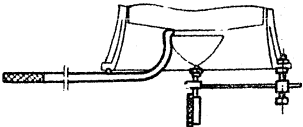
50X1-HUM

	<p>47A-232-496</p>	<p>Mounting eye-bolt for the jack cover</p> 	
	<p>47A-232-208</p>	<p>Eye-bolt for removing the labyrinth seal sleeve from turbo-supercharger rotor shaft</p> 	
	<p>47B-232-053</p>	<p>Fuller to press out the injector needle valve lift limiter</p> 	

255

50X1-HUM

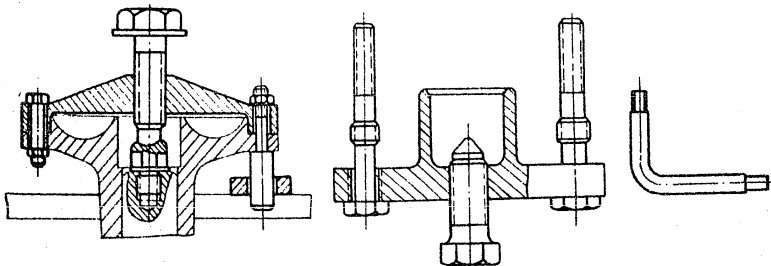
256

1	2	3
61B-232-302	Guide bushing for assembling and dis-assembling the turbo-supercharger	
47A-232-211	Bushing to guide the turbo-super-charger rotor when lowering it down	
47A-232-212	Wrench for the nut (fairing) of turbo-supercharger impeller	
47A-232-096	Appliance to check axial travel of turbo-supercharger rotor (when measur-ing the rotor axial play)	

50X1-HUM

3

50X1-HUM


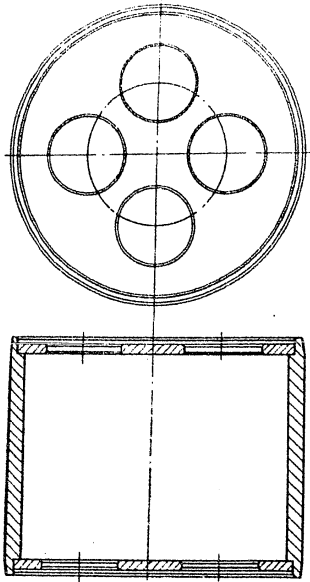
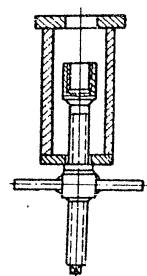
1	2	3
<div data-bbox="300 1684 1002 1814"></div>	<div data-bbox="397 1428 430 1585">47H-232-087</div> <div data-bbox="376 987 451 1369">Puller to remove the bow driven rotor of turbo-supercharger fluid coupling</div>	<div data-bbox="256 493 1023 756"></div> <div data-bbox="747 1428 779 1585">47H-232-084</div> <div data-bbox="738 987 787 1369">Puller to remove the water pump impeller</div> <div data-bbox="950 1459 982 1585">22-232-015</div> <div data-bbox="950 955 982 1344">Wrench for governor coupling bolts</div>

50X1-HUM

257

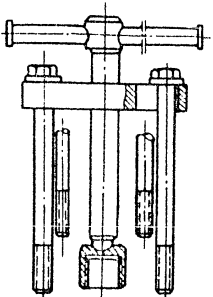

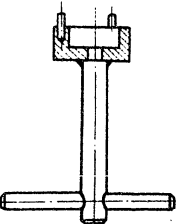
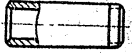
50X1-HUM

258

1	2	3
22-232-901	Fuller to press out the governor slide valve bushing	
47A-232-098	Appliance for measuring the clearance in crankpin bearings	
47A-232-045	Appliance for pressing the supercharger impeller and inducer on the turbo-supercharger rotor shaft	

50X1-HUM

50X1-HUM

1	2	3	50X1-HUM
47A-232-058	Puller to remove the super-charger impeller and turbo-super-charger inducer		  
22-233-027	Special wrench		
22-233-251	Pin-type socket wrench		
22-232-014	Cup to prime oil into governor		

50X1-HUM

50X1-HUM

280

1

2

3

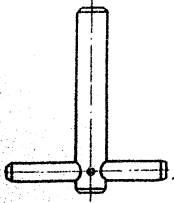
22-232-022

Socket wrench for the remote control panel setter



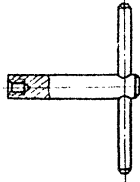
22-232-221

Eye-bolt (with internal thread) for the starting valves and intermediate valves of remote control panel



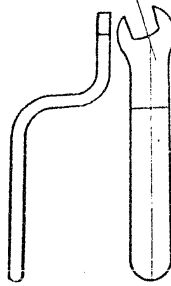
22-232-191

Eye-bolt (with internal thread) for the control panel starting valves



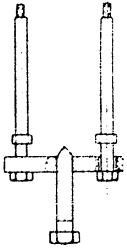

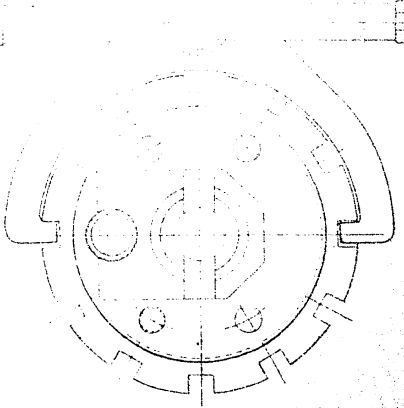
22-233-026

Special wrench



50X1-HUM

50X1-HUM

1	2	3
47A-232-085	Puller to remove the water pump oil seal bushing	
47B-232-196	Handle assembly to crank the shaft barring arrangement	
61B-232-002	Appliance to tighten up the starting valve pipe union nuts	

201

50X1-HUM

50X1-HUM

Oil-control piston ring remover
and inserter

61B-232-053

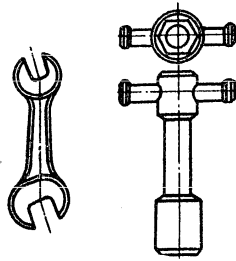
Standard Tools

Double-end flat wrenches: 6 x 8,
5.5 x 7, 8 x 10, 12 x 14, 17 x 19,
22 x 24, 27 x 30, 32 x 36, 36 x 41,
46 x 50

7611-0000

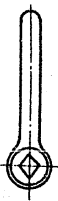

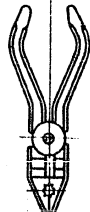
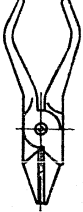




Socket wrenches: 10, 12, 17,
19, 22, 27, 32, 36, 46

08318-20




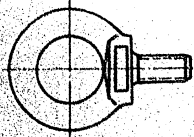

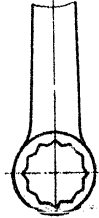
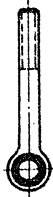
50X1-HUM

50X1-HUM

1	2	3
06262-00	Single-end wrench for squares	
08322-00	Single-end wrenches for round nuts: 22 x 26, 45 x 52, 100 x 110, 26 x 32, 78 x 85, 38 x 42, 90 x 95	
7014-0090	Combination flat pliers 200	
08277-00	Round-nose pliers 175	
08154-80	Cotter pin pullers: 150 x 2, 250 x 4	
08248-00	Screw driver, 0.4 x 100	
08248-20	Screw drivers: 0.5 x 100, 0.7 x 175, 1.0 x 200, 1.4 x 250	
08154-00	Hand punches: 2, 6	


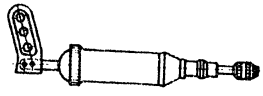
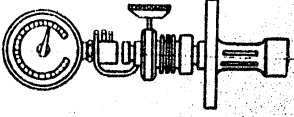
50X1-HUM

50X1-HUM

1	2	3
06360-00	Nuts for screwing the threaded studs in and out: M8, M10, M12, M14, M16, M20	
06360-20	Nut M10 x 1	
06360-00	Load screw M8 to lift the governor	
06360-10	Socket wrench for plugs 7 x 12 of control panel intermediate valves	
06360-50	Star-shaped wrench 36 for injector	
06360-5520	Hinged bolt M6 x 50 to take out the pistons of control panel intermediate valves	

50X1-HUM

50X1-HUM

1	2	3
02310	Press out screw M16 x 40 to press the main drive and the major accessories drive off the frame	
GOST 3613-54	Model I rod-type grease gun with head.	
Specific. Bty No.000-102	Model 17/11 maximum pressure indicator, rated for a pressure of 160 kgf/cm ²	

50X1-HUM

50X1-HUM

	Page
Air Cooler with Branch Pipes	39
Chapter VI, TURBO-SUPERCHARGER	40
Chapter VII, FUEL FEED SYSTEM	45
Fuel Feed System Diagram	45
Constant Pressure Valve	45
Fuel Filter	48
Fuel Feed Pump	49
High-Pressure Fuel Injection Pump	50
Injector	53
Chapter VIII, LUBRICATING SYSTEM	55
External Circuit	55
External Main Circuit	55
External Auxiliary Circuit	57
Internal Circuit	57
Oil Pump	59
Oil Filter	61
Oil Cooler	61
Chapter IX, COOLING SYSTEM	62
Fresh Water System	62
Sea Water System	63
Water Pump	63
Fresh Water Cooler	67
Chapter X, STARTING AND SPEED-CONTROL SYSTEM	68
Air Filter	68
Remote Control Panel	68
Control System Arrangements	79
Pneumatic Setter	79
Speed-Control Servo-Motor	79
Emergency Control Station	79
Control Shafts, Rods and Levers	80
Governor Remote Control Mechanism	83
Main Starting Valve	83
Working Cylinder Starting Valve	83
Starting Air Distributor	85
Control Selector Switch	85
Overspeed Governor Actuating Mechanism	87
Fuel Feed Limiter	87
Functioning of Starting and Control System	87
A. Starting the Diesel Engine from the Remote Control Station	89
B. Starting the Diesel Engine from the Emergency Control Station	90
C. Changing the Diesel Engine Speed	90
D. Stopping the Diesel Engine	92

276

50X1-HUM

50X1-HUM

	Page
Speed Governor	92
General	92
Main Specifications	94
Governor Design	100
Governor Operation	111
Chapter XI. AUTOMATIC WARNING SIGNALLING SYSTEM	115
Key Diagram of Automatic Signalling System	115
Primary Instruments (Sensors)	120
Secondary Instruments	120
Signal Panel	120
Signal Box	121
Chapter XII. MEASURING INSTRUMENTS	122
Chapter XIII. SHAFT BARRING ARRANGEMENT	124

Part II

OPERATING AND MAINTENANCE INSTRUCTIONS

Chapter I. GENERAL	125
Fuel	125
Oil	126
Water	127
Air	127
Chapter II. OPERATING THE ENGINE	128
Preparing the Diesel Engine for Starting	128
A. Preparing the Diesel Engine for Starting After Repairs, Overhaul, or Long Period of Standstill	128
B. Preparing the Diesel Engine for Starting During Daily Operation	131
Starting the Diesel Engine from the Emergency Control Station	133
Starting the Diesel Engine from the Remote Control Panel	134
Changing Over the Control from the Remote Control Panel to the Emergency Control Station, and Vice Versa, During Diesel Engine Operation	134
Servicing the Diesel Engine During Operation	135
Basic Ultimate Parameters of Diesel Engine During Operation at Rated Power and Speed	136
Stopping the Diesel Engine	138
Starting the Cold Diesel Engine and Bringing It to Full Power in Emer- gency Cases	139
Measures to Be Taken when a Signal Is Sent by the Warning Signalling System	140
Measures to Be Taken when the Safety (Explosion-Proof) Valves Ope- rate	140

277

50X1-HUM

50X1-HUM

	Page
Peculiarities of Operating the Diesel Engine on Units with Variable-Pitch Propeller and "Linija" Control System	142
Chapter III. MOST CHARACTERISTIC ENGINE TROUBLES, THEIR CAUSES AND REMEDIES	143
Chapter IV. SCHEDULED PREVENTIVE INSPECTIONS AND REPAIRS	151
Inspection No.1	151
Inspection No.2	152
Inspection No.3	152
Inspection No.4	153
Inspection No.5	154
Inspection No.6	154
Inspection No.7	155
Inspection No.8	156
Chapter V. DISASSEMBLY, INSPECTION, REPLACEMENT AND ASSEMBLY OF DIESEL ENGINE PARTS AND UNITS	157
General	157
Main Bearings	158
Upper Crankshafts	161
Connecting-Rod-and-Piston Assembly	163
Working Cylinder Sleeve	170
Fuel Injection Equipment	173
A. Injector	173
B. High-Pressure Fuel Injection Pump	175
Turbo-Supercharger	179
Disassembling the Turbo-Supercharger	179
Inspection and Replacement of Parts	180
Assembly and Installation of Turbo-Supercharger on Diesel Engine	181
Starting System Units	183
A. Starting Air Distributor	183
B. Main Starting Valve	184
C. Working Cylinder Starting Valve	185
D. Emergency Control Station Starting Valve	185
Overhauling the Seals of Injector and Starting Valve Pipe Unions, and Seals of Fuel Feed and Water Pumps	186
A. Overhauling the Seals of Injector Pipe Unions	186
B. Overhauling the Seals of Starting Valve Pipe Unions	186
C. Overhauling the Fuel Feed Pump Seal	187
D. Overhauling the Seals of Fresh and Sea Water Pumps	188
Fuel and Oil Filters	189
A. Fuel Filter	189
B. Oil Filter	189

50X1-HUM

50X1-HUM

	Page
Chapter I. CHECKING THE SYSTEM OF THE DIESEL ENGINE AND ADJUSTING THE	
DIESEL ENGINE	191
Checking the Systems	191
A. Checking the Diesel Engine Starting System	191
B. Checking Proper Linkage of Control Rods and Levers with the Emergency	
Control Station, Governor, Fuel Injection Pumps and Overspeed Governor	192
C. Checking the Fuel System for Proper Sealing and Setting the Fuel Injection	
Advance Angles	194
D. Checking the Fresh and Sea Water Systems	195
E. Checking the Lubrication System	195
F. Checking the Speed Governor Remote Control System for Proper Functioning	196
Running-in and Adjusting the Diesel Engine During Operation	196
APPENDICES:	
1. Model PI3M-4 Speed Governor Mounting and Maintenance Instructions	203
2. Remote Control Panel Maintenance Instructions	210
3. Instructions for Mounting and Maintenance of Type CAC 24B-55 Signalling System	
Instruments	213
4. Specifications of Fuel	215
5. Specifications of Oil M-20Г According to Local Standard MPTV 12H No.24-63	216
6. Mounting and Operation Clearances	216
7. Rated Weights of Diesel Engine Main Units and Parts, and of the Furnished	
Equipment	220
8. Marking the Diesel Engine Units and Parts	221
9. Charts Showing Change of Exhaust Gas Temperature Upstream of Turbine Depending	
on Speed at Propeller and Limiting Performance	224
10. Diesel Engine Universal Performance with Regard to Relative Hourly Consumption	
of Fuel	224
11. Instructions for Removing Carbon from Pistons	224
12. Instructions for Maintenance of Oil, Water and Air Coolers	226
13. Instructions for Tightening-Up the Connecting Rod Threaded Joints	233
14. Instructions for Application of Type ГЭН-150/В Glue for Fitting the Rubber	
Rings on Cylinder Sleeves	234
15. Instructions for Preparation of Grade ВЗЛ Putty	236
16. List of Measuring Instruments and Automatic System Devices Delivered with	
Diesel Engine	236
17. List of Mounting Tools and Appliances	239
18. Oils and Lubricants Used for Diesel Engine	266
19. Instructions for Introducing Grade ВНИИ НП-117 Additive into Cooling Water	266
20. Instructions for Slushing and Unslushing the Diesel Engine and Spare Parts	269

278

50X1-HUM

50X1-HUM

Page Denied